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HYDROVAC
THE POWER BRAKE PREFERRED ABOVE ALL OTHERS!
More than two million installations are certainly undeniable proof of any product's popularity. In the field of power braking it means that one—the Bendix Hydrovac—is preferred above *all* others. Such overwhelming acceptance by the men who service, drive and own the nation's trucks is impressive enough in itself. It further suggests, however, that Hydrovac* power braking might very profitably be included as original equipment by most manufacturers. If you are interested in taking advantage of this great pre-sold market, write the factory direct for details on Hydrovac—the undisputed leade in power braking.
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DIVISION o
SOUTH BEND 20, IN
BUILDERS
OF THE BASICS
OF BETTER
MOTOR VEHICLES

MILITARY OVERTONES DOMINATE ANNUAL MEETING

OVERTONES of mobilization ran through almost every session of SAE's first Annual Meeting in the second half of the 20th Century. And the preparedness theme dominated the meeting's largest gathering—the 1951 Annual Meeting Dinner. There Under Secretary of the Army Archibald S. Alexander, the main speaker, emphasized the necessity for current plans to make United States strong. The speaker's table included many of the nation's most distinguished military leaders as well as outstanding industrialists upon whom war production responsibilities rest. Many technical committee meetings concerned themselves with war-born problems.

Throughout the Jan. 8-12 sessions at the Book Cadillac Hotel in Detroit, discussions were sharp and papers illuminating. Attendance stayed at the peaks of recent years, and the Engineering Display drew interested visitors all week.

The Annual Business Session of the Society was held Tuesday evening. There the Tellers of Election reported the results of the balloting for 1951 officers, including the election of the late James E. Hale as President. Following this session, the 1951 Council met and—as required by the Constitution—elected one of its own number to fill the Presidential vacancy left by Hale's untimely death. They elected Dale Roeder, executive engineer, commercial vehicles, Ford Motor Co., as 1951 SAE President. Then they chose SAE Past-President L. Ray Buckendale, vice-president of engineering, Timken-Detroit Axle Co., to fill Roeder's unexpired term as 1950-1951 Councilor. (See page 51.)

Twenty-three technical sessions and 47 papers threw new light on topics ranging all the way from military-type powerplants to traffic safety; from involute splines to truck refrigeration.

Some researchers reported progress, for instance, in making ignition systems more reliable in all kinds of weather—and responsive to the demands of high compression engines. Others told of three-way progress in refrigerated transportation equipment: by raising efficiency of truck bodies, by refining use of power from truck engines to produce refrigeration, and by perfecting the refrigeration systems themselves.

New, faster manufacturing methods were declared ready for the switch from civilian car and truck production to military vehicle manufacture.

The impact of military preparedness was shown to be shifting trends in various types of fuel. Gasoline was seen to be meeting growing competition from liquefied petroleum, particularly in farm areas. . . . Motor transport operators agreed on the need to cut maintenance costs—and disagreed about the best ways to cut them. . . . In every area of automotive engineering common problems were met and argued. Many sessions were packed to capacity.

The Beecroft Memorial Lecture and the Horning Memorial Lecture both were a part of this 1951 Annual Meeting program.

Sidney Williams, assistant to the president, National Safety Council, and winner of the Beecroft Award said: "Safety means doing things right. It means achieving what you set out to do. Forget the personal injury; even the death. Safety is a *quality*, present or absent in everything we do. . . . The

(Continued on Page 56)

UNDER SECRETARY OF THE ARMY ARCHIBALD S. ALEXANDER was the chief speaker at the Annual Meeting Dinner on Wednesday evening, January 10

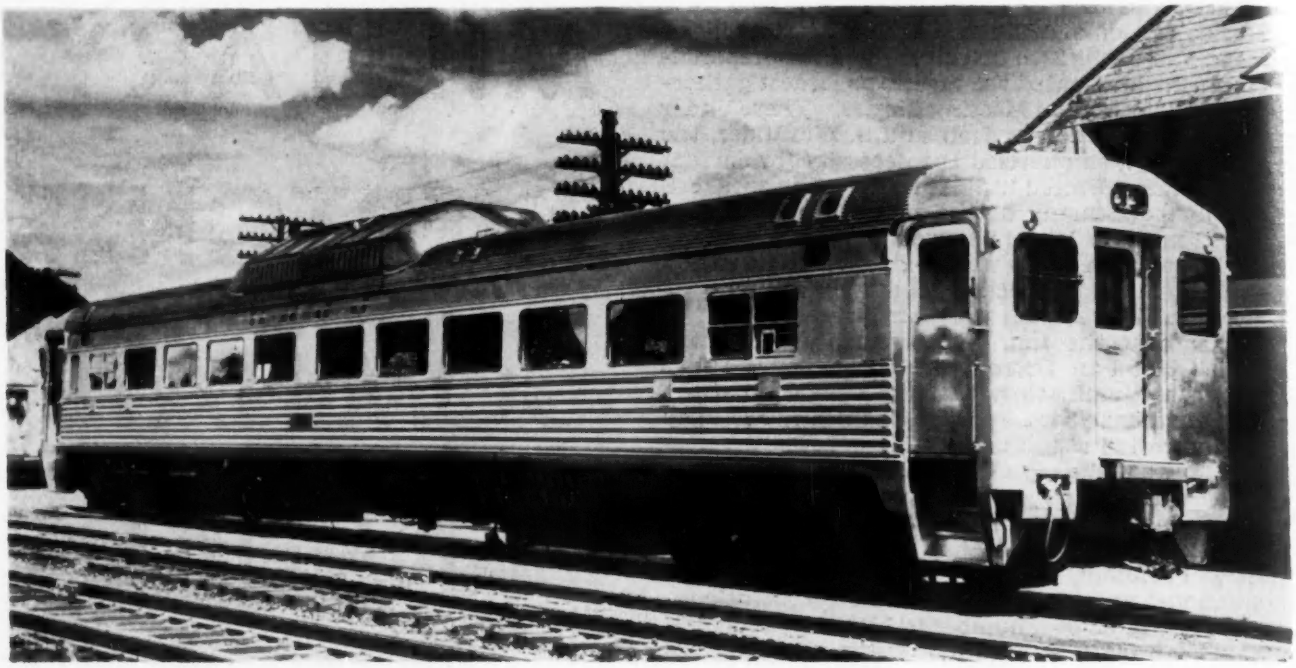


Fig. 1—Diesel railroad car exterior

NEW BUDD DIESEL

THE designers of the new Budd diesel railroad car (Fig. 1) have placed special emphasis on developing features that would give maximum utilization at lowest cost. Thus, every effort was made to attain:

- Maximum revenue space.
- Low initial and operating costs.
- Maximum availability.
- Operating reliability.
- Quick delivery.
- High performance.

The engines were placed under the car floor, and the dome section of the roof was designed to contain the engine cooling radiators, for example, so they would not encroach on revenue space.

Probably the most important factor in attaining low initial cost—as well as quick delivery—is the policy of offering four standard floor plans instead of custom building cars to every different railroad specification, as is the usual practice in railroad passenger-car manufacture. These four plans, which provide for a rather wide variety of operating requirements, are being offered to prospective purchasers of any number of cars at a fixed price announced in advance. In fact, 10 cars of two types were put into production before a single order was received. By this procedure cars can often be offered off the shelf for immediate delivery—and if not, delivery is made in one-half the usual time.

A further reduction in cost has also been made possible by careful selection of engines. Instead of one large powerplant, two 275-hp units are used, for which there is much more general industrial demand. In this way it has been possible to benefit from automotive production methods on larger quantity production of a basic engine. The result is a sizable reduction in initial car cost, as well as in cost of parts and space power units.

Special attention was given to getting low maintenance cost and maximum availability. Although installed so as to be accessible for maintenance, the 275-hp engines—each light enough for easy handling—can be completely replaced in less than 2 hr. This means that it is not necessary to move the whole car to the back shop for engine overhauls and also eliminates need of working over a pit to service engines. This is an extremely important point because the whole car is designed on the philosophy of no overhaul of power unit on the car and extremely

THIS article is the first of a series on the new Budd diesel railroad car. Many of the more important features of the car itself are covered here, such as the structure, interior appointments, heating and ventilating system, and brakes.

The next article, which will appear in an early issue, will describe the torque converter and transmission, and will be based on a paper by R. M. Schaefer, Allison Division, GMC.

The final paper will cover the diesel powerplant used on this car. It will be based on a paper by Vernon Schafer, Jr., Detroit Diesel-Engine Division, GMC.

RAILROAD CAR–PART I

BASED ON PAPER* BY

Benjamin Labaree, Chief Engineer, Railway Equipment Division, Budd Co.

* Paper, "New Budd Diesel Railroad Car RDC with Torque Converter Transmission—The Car," was presented at the SAE National Diesel-Engine Meeting, Chicago, Nov. 2, 1950.

rapid engine change. If false economy or initial lack of foresight prevents a railroad from buying extra engines—space engines, as they are called—one of the biggest contributions to car availability has been lost.

The use of two engines provides another important advantage in the form of greater operating reliability, for even with one engine not functioning, a single car can complete its run on one engine at a reasonable speed. In direct drive it can operate at 62 mph on a level track with full throttle or at 50 mph in torque converter with two-thirds throttle.

The disc brake also helps to keep maintenance expenses low. Considerable annual saving in brake shoe cost can be achieved over clasp brake shoes (100,000 miles per disc shoe instead of 6000 miles per clasp shoe). Also, the generally accepted clasp brake perennial wheel troubles, such as heat checks of the wheel tread, are eliminated.

Fuel economy is also good. The demonstrator car has run more than 68,000 miles with an average consumption of better than 2½ mpg—about 3¢ a mile for fuel. Of course, runs that require many closely spaced stops will have poorer fuel economy. Constant running at full throttle also has a detrimental effect on fuel economy, as well as on engine maintenance.

That low operating costs were attained can be judged from Fig. 2, which compares the running costs of a steam train with those for an RDC train. In fact, studies indicate further that on the basis of same passenger capacity the RDC is cheaper to operate than a bus.

In getting these special features, performance has by no means been neglected. For example:

1. Engine horsepower and gear ratio are such that a speed of 85 mph can be reached on a level track.

2. Rapid initial acceleration of 1.4 mph per sec can be reached. (All-electric multiple unit railcars give 1.1 mph per sec.)

3. Disc brakes produce a retardation up to 3.5 mph per sec in emergency and 2.8 mph per sec in service

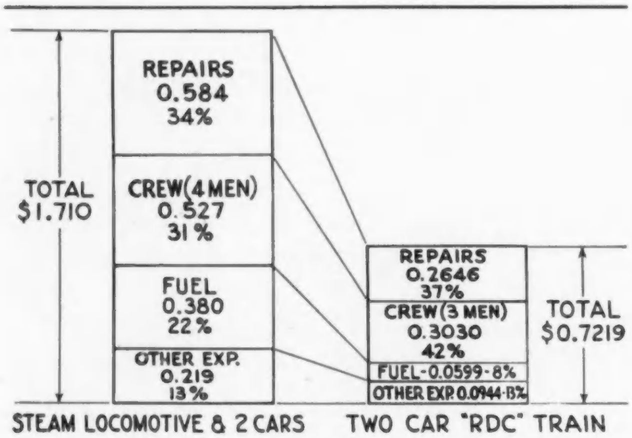


Fig. 2—Comparative running costs per train-mile

braking. (A fully loaded car has been stopped in 2330 ft from 85 mph using service braking only. This length can be reduced to 1900 ft with emergency braking.

Many other detail design features have contributed, of course, to attaining these objectives.

The car body is primarily a modified box beam of stainless steel. It is made up basically of a longitudinally corrugated roof welded to curved transverse Z-shaped carlines with a raised dome section near the middle that houses the roof radiators and cooling fans, engine air intake, and exhaust pipes and bell.

In order to obtain the proper vertical dome depth to house the equipment and not to exceed a height above the rails that would restrict the operation of the car on any railroad, the height of the top of the dome was set at 14 ft 7 in. above the rail and the main roof height at 13 ft 1 in.

The sideframes are built as modified plate girder shear-carrying members connecting the roof and the floor, which are the main chord members of the box beams. The sideframe is made up of vertical posts tied together in a girder by welding to continuous longitudinal roof rails, longitudinal plates, and widely spaced corrugations above and below the windows and at the floor and by welding to flat sheets between windows.

The floor is a very strong horizontal plate girder made up of many closely spaced transverse floor members 4 in. deep, which, when shotwelded together at their extended bottom flange, form a continuous bottom surface. They rest at the centerline on a stainless-steel hollow box section center sill, which runs between body bolsters. They are also braced by three stainless-steel crossbearers and by a welded low-alloy carbon steel combined rear engine support and crossbearer at the transmission end of each engine. At the ends of the car an arc-welded NES70 low-alloy carbon steel end underframe unit is used that includes the draft sill extension, body bolsters, center plate, and combined end sill and coupler carrier support connected to the center sill and remainder of the floor by stainless-steel arcwelding.

The total car body has an overall balanced strength to meet all required loads and to develop resistance to all types of collision loads without individual weak spots. This balance has been obtained by the testing to destruction of full-size complete car bodies and components in the research test plant.

The interior is easy to maintain, attractive to passengers, adequate in accommodations, low in weight, and low in cost.

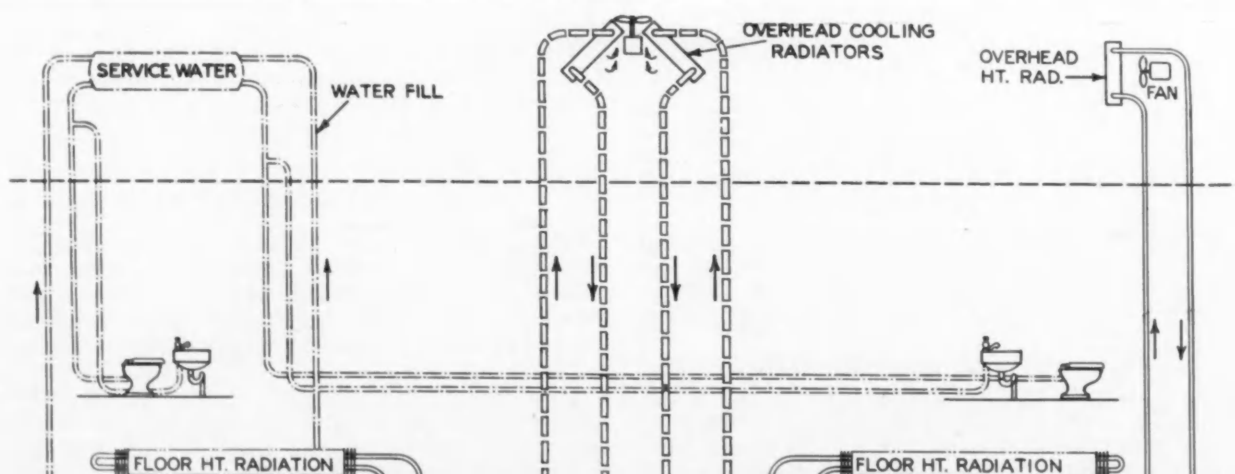


Fig. 3—Heating and service water system

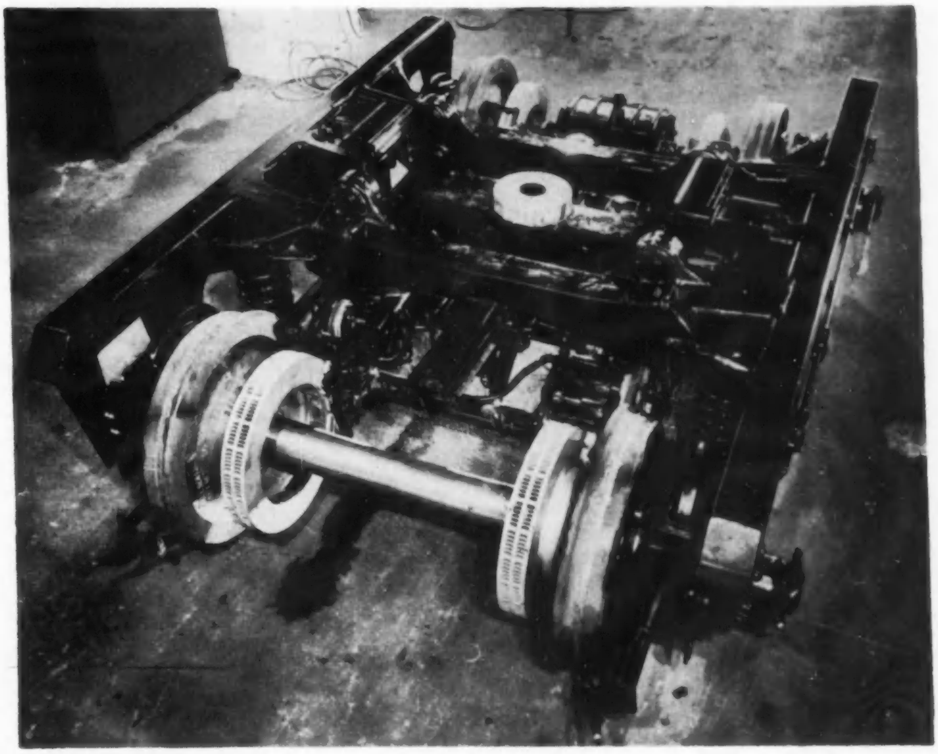


Fig. 4—RDC truck shown above is of four-wheel, single-equalizer, single-bolster, swing-hanger type equipped with coil bolster and equalizer springs, longitudinal bolster anchor rods, and transverse bolster stabilizing rods

In the passenger compartments, the seats are of the walkover type for quick turnaround, with tough, easy-to-clean Koroseal covering and stainless-steel aisle pedestals. Bag racks of the continuous open type extend above all seats, which contain individually controlled seat reading lights. Fluorescent ceiling lights are located over the aisle. Easy-to-clean plastic roller curtains are supplied at each passenger window. The floors are covered with long-lasting Terraflex tile set in attractive patterns. The walls and ceiling are painted in two-tone red and tan, and the seat upholstery is Chinese red for the backs and blue for the cushion.

Equipment

Air Conditioning and Ventilation—The passenger sections of all cars are air conditioned by conventional electromechanical freon air conditioning equipment of 7-ton capacity, consisting of an electric-motor-driven freon compressor and a dry condenser located under the car. Above the vestibule ceiling at the handbrake end of the car are mounted the electric blowers drawing air in through screened roof intake ducts and forcing through the freon evaporator cooling unit mounted above the coach section ceiling just inside the body end door.

Heating System—The car is heated by means of a circulating water system drawing hot water from two 75-gal sump tanks under the car, which are a part of the engine cooling system. (See Fig. 3.) A thermostatistically controlled motor-driven circulating pump near one engine (separate from the engine water pump) forces hot water from one insulated sump tank through finned radiators in the compartments of the car. A similar pump near the other engine forces water from the other sump tank through the overhead heating coil, which is part of the evaporator assembly. The overhead coils have a capacity of 80,000 Btu per hr, taking engine water at 176 F, and the floor heat coils have a capacity of 147,000 Btu per hr.

Tests in the climate laboratory have proved that the car interior can be kept at 70 F with an outside ambient temperature of 0 F with both engines idling—a condition corresponding to a long downhill run with engines idling to supply heat to the radiators and electric power for all the services, such as air compressor and lighting. The demonstration car also proved this in a long run down from Moffatt Tunnel for 2 hr with an outside temperature of about 0 F.

The motorman's station in the vestibule has an electric heater at one side, a rubber encased heating element on the end sheet, and a thermostatically controlled electrically heated glass windshield to prevent fogging and icing.

Electrical System and Lighting—The car is provided with a nominal 64-v d-c electrical system. The current is supplied by two generators connected in parallel and mounted under the car—one at each engine—driven from the front crankshaft flange through resilient coupling rings, universal joints, and a splined shaft. Each generator delivers 15 kw at 700 rpm engine idle speed.

All electrical equipment except main car lighting will operate on unregulated voltage from 56 to 76 v d-c.

A 284-amp-hr battery is provided for engine starting and controls and a 64-v d-c battery charging receptacle provided on each side of the car for plugging into a yard electric source.

Each car is equipped with a 12-wire electric trainline with receptacles and jumpers providing for trainlining of engine control circuits, sanding, sig-

nal buzzer, and compressor synchronizing circuits.

The lighting of the main passenger compartments operate on 61-v d-c regulated voltage including the fluorescent fixtures, which use 15-in. 14-w tubes.

Truck Brakes—The truck-mounted brakes (Fig. 4) are of the Budd disc type comprising two pairs of cylinders per truck. Each pair of cylinders is mounted on a transverse welded tubular frame centrally supported in a substantial rubber brushed bracket at the middle of the truck center transom and supported at each end by a longitudinal arm that straddles the journal box at the end of each axle between wheel and truck pedestal. Each brake cylinder operates tongs that clamp the composition brake shoes against both sides of a cast-iron brake disc bolted to the inside hub of each wheel. The disc has built-in vanes between contact faces to provide for rapid heat dissipation.

The Budd disc brake has a background of over 400,000,000 car-miles of successful operation on many railroad mainline passenger and baggage cars since the first brake went into service 12 years ago. The record made by the brake in quick stopping ability, low maintenance cost, and elimination of heat-checked wheels makes it an increasingly reliable piece of equipment for any railroad.

Due to the practically uniform friction characteristics at all speeds of the composition brake shoe lining, no speed governors are required to step down the braking pressures with decreasing speed, as is required with clasp brakes to obtain high braking ratios without wheel slide. By reason of the flexible mounting of each brake assembly, so that the brake rigging follows the wheel without interference with truck spring action, and by reason of the composition shoe, braking is very quiet and smooth.

The lever type of handbrake mounted on the collision post in one vestibule operates through a chain, pull rod, and crank to spread the brake tongs and apply the brakes on one disc on each axle of the truck adjacent to the handbrake. The handbrake will produce 25% of the loaded weight of the car.

Fig. 5 shows brake retarding forces, stopping distances, and instantaneous decelerations for the car in both service and emergency braking.

Trucks—The trucks are of the 4-wheel, single-equalizer, single-bolster, swing-hanger type equipped with coil bolster and equalizer springs, longitudinal bolster anchor rods, and transverse bolster stabilizing rods. (See Fig. 4.) To save weight the truck frame has no end transoms, which is made possibl by the absence of clasp brake rigging. Shock ab sorbers snub vertical bolster motion. Wheel base i 8 ft 6 in., wheel diameter is 33 in., with rims and hub machined to improve wheel balance. One axle o each truck is machined to accommodate the driv gear unit thrust collars and to provide a splined center portion suitable for mating with the drivin gear.

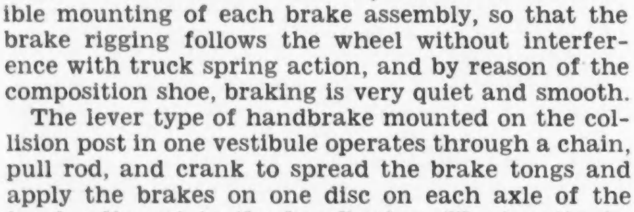


Fig. 5—Disc braking performance

The truck structure is designed for minimum weight and lowest cost without sacrifice of adequate rigidity, strength, or service life in order to be consistent with the overall RDC design philosophy of cutting out every pound of excess weight and cost. For this reason the truck frame is designed for economical manufacture from NES70 steel plates, shapes, and alloy steel castings welded together, then stress relieved after all primary welding is complete. The truck bolster and spring plank are also fabricated out of welded NES70 plates stress relieved after welding. The equalizers are drop-forged, alloy steel of an I-beam section standard in all Budd trucks. They are much lighter than the conventional rectangular bar equalizers (60% of weight) and have a higher safety factor.

The resulting truck has clean lines, open, easy access to truck parts, good riding qualities, and is generally well suited to RDC service.

Axle Drive Unit—The drive unit takes its power from the flanged output shaft of the power unit through a bolted flanged coupling and universal joint, a telescoping tubular splined propeller shaft, and another universal joint, and bolted coupling flanges at the pinion shaft of the axle unit. The propeller shaft incorporates grease fitting, dust seal, and rubber drive cushioning to damp out torsional impulses.

The axle unit consists of a 26-tooth spiral bevel gear driving a 54-tooth ring gear, which is bolted to a splined quill mating with the splines on the drive axle. The housing of the gear unit is coupled by a torque arm to the center truck transom through resilient mounts to compensate for lateral and vertical motion of the axle relative to the truck frame and to cushion torque impulses. Axial and radial alignment of the unit on the axles is maintained by tapered rubber bushings, which are clamped between the axle and a tapered seat on each side of the gear housing.

Engine Box—The engine is enclosed in a sound-deadened box with hinged drop doors in the front for quick access to the engine control box and instruments. This box is quickly removable in five sections for complete engine access or engine removal. The box materially reduces the sound level at the side of the car when it is standing in stations. At the same time, tests show that engine box interior temperatures under severe operating conditions remain safe with no induced ventilation. The box also serves to protect engine components from damage by flying ballast and keeps dirt, ice, and snow from accumulating on the engine. This is a factor in increasing engine reliability.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Octane Needs Of Postwar Cars

BASED ON PAPER* BY

H. W. Best, H. J. Gibson, and J. E. Taylor

Yale University — Ethyl Corp. — Gulf Oil Corp.

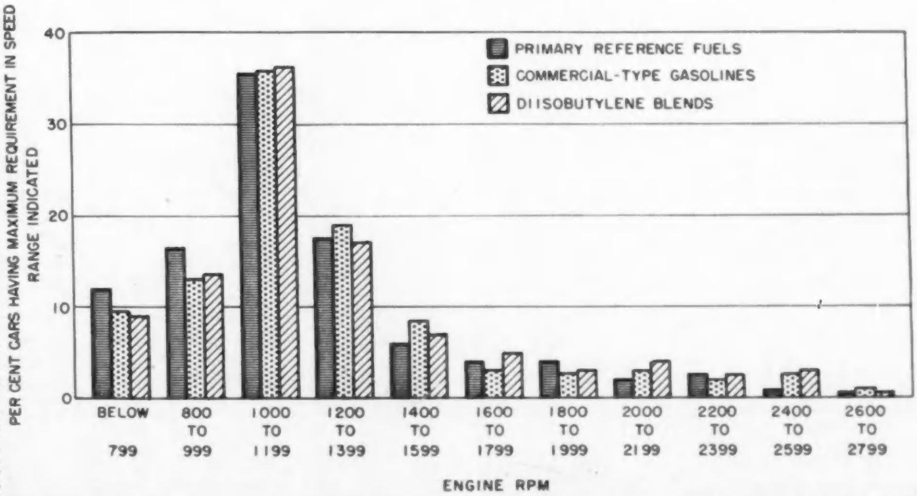
* Paper "Antiknock Requirements of Passenger Cars (1949 CRC Octane Number Requirement Survey)," was presented at SAE National Fuels & Lubricants National Meeting, Tulsa, Nov. 10, 1950. This paper will be printed in full in SAE Quarterly Transactions. Multilithographed copies of the full paper also are available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.

ANTIKNOCK requirements of postwar passenger cars were surveyed in 1949 by the Equipment Survey group of the CFR Motor Fuels Division. The survey covered 306 cars on the road, representing the 1946, 1947, 1948, and 1949 models of 19 makes. Thirty-five engines of 16 makes, considered by the manufacturer to be representative of his production, also were tested.

Results of this octane number requirement study indicate:

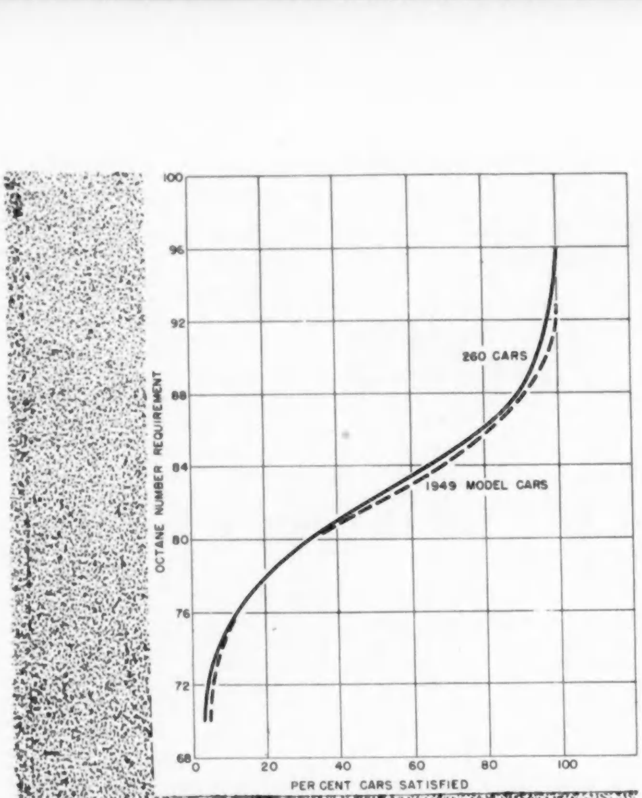
1. Maximum octane number of requirements based on Research octane numbers of the commercial-type fuels were somewhat higher than those based on primary reference fuels. In the octane number range of current commercial gasolines, this difference amounted to two octane numbers.
2. Blends of diisobutylene, iso-octane, and n-heptane, matching the commercial-type fuels in Motor and Research octane numbers, follow closely the commercial-type fuels in antiknock behavior.
3. About 50% of the cars in hands of customers knocked on fuel found in the gasoline tanks.
4. The spread in octane number requirements of today's engines, which manufacturers consider to be representative of their production, was almost as great as that found among the 1946 to 1949 cars tested.

The charts on this and the following three pages detail these results more fully.



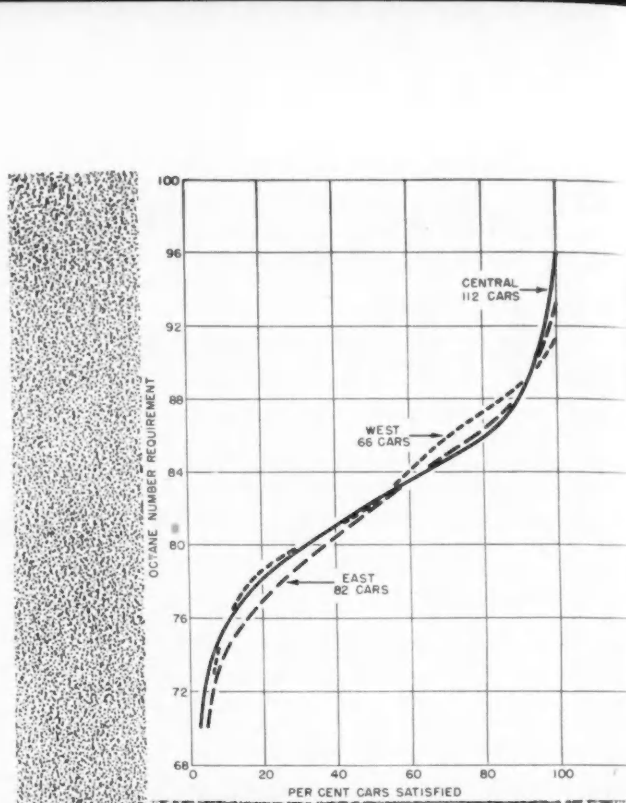
Speed for Maximum Requirement

These are the engine speeds at which maximum antiknock requirement occurred with the three sets of test fuels. About 80% of the cars tested had maximum requirement below 1400 rpm on all three fuels. Therefore, analyses based on maximum antiknock requirement pertain primarily to knocking at the lower engine speeds.



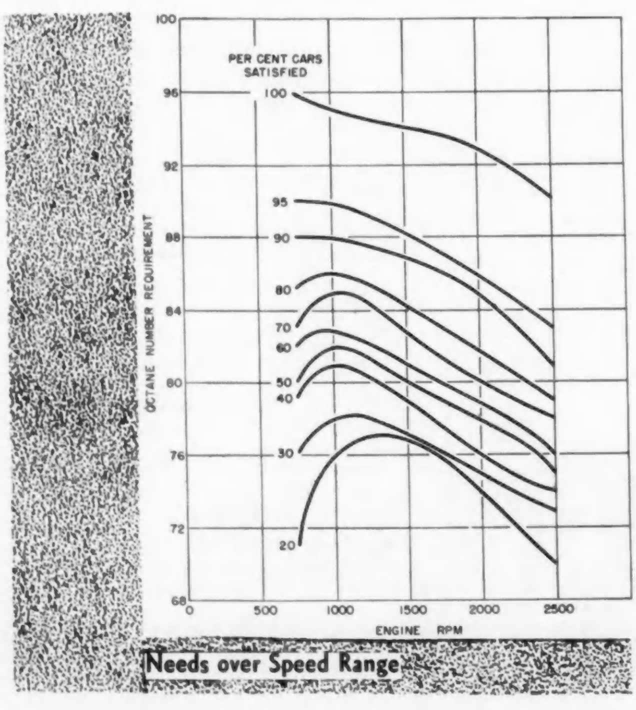
Distribution of Maximum Requirements

Distribution of maximum octane requirements, in terms of primary reference fuels, shows the 112 1949-model cars had about the same requirements as all of the 260 cars.



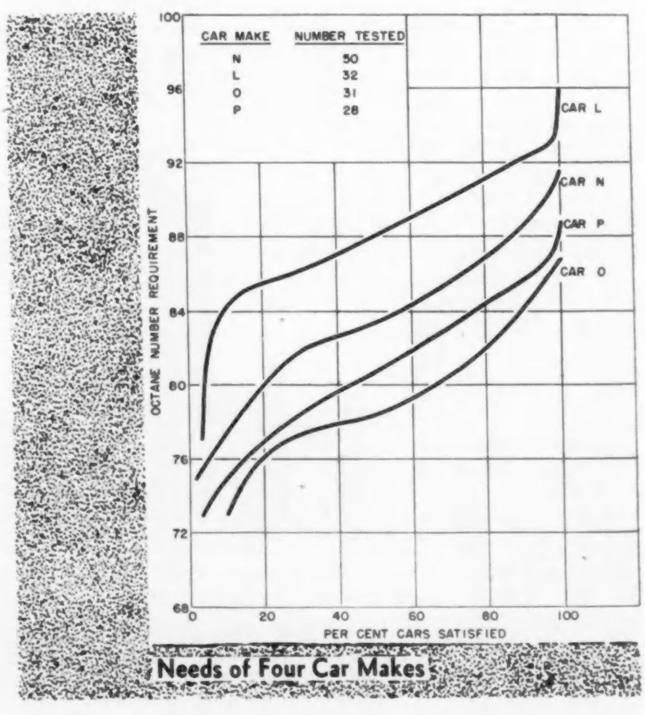
Geographical Distribution

There was no significant difference among the cars located in the Eastern, Central, and Western parts of the country, according to survey results.



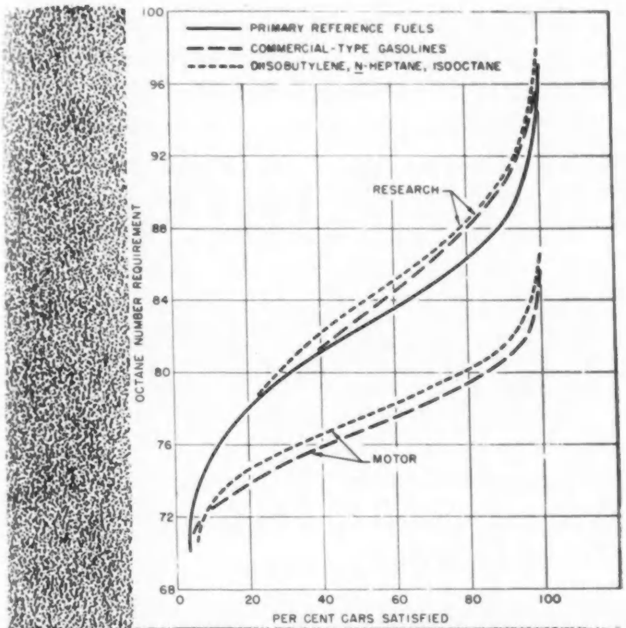
Needs over Speed Range

This is the distribution of octane number requirements over the speed range. These are composite curves. No one car necessarily defines any particular curve.



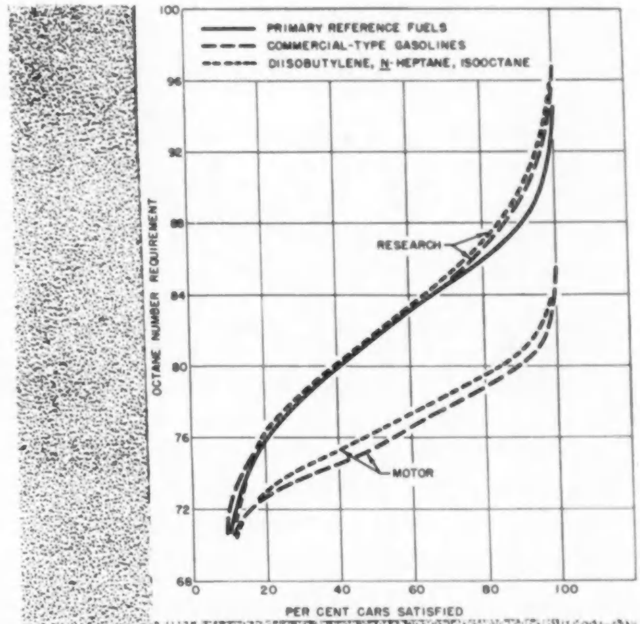
Needs of Four Car Makes

These maximum antiknock requirement data for four popular car makes with primary reference fuels show that significant differences exist among car makes.



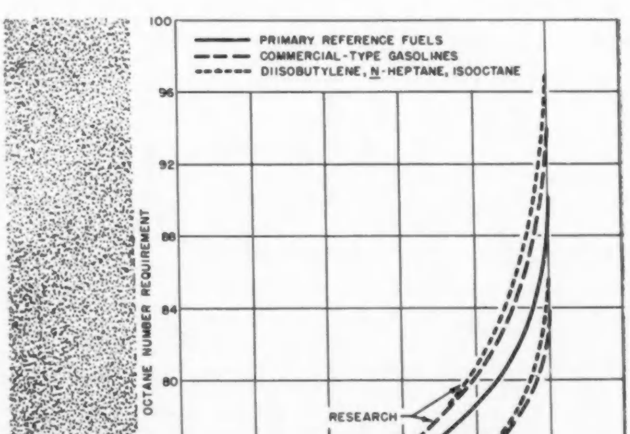
Research and Motor Ratings

Road ratings of fuels are 0 to 2 octane numbers below their Research Method ratings. The diisobutylene blends follow closely the commercial-type gasolines.



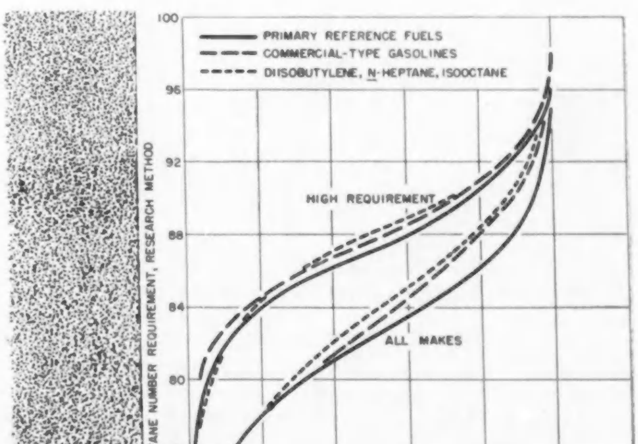
At 1000 rpm

Distribution curves at 1000 rpm show requirements, based on Research octane numbers, to be substantially the same for the three types of fuel used.



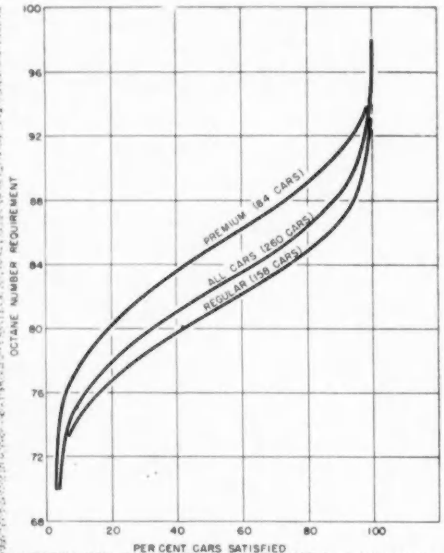
At 2500 rpm

Commercial fuels and diisobutylene blends match, but curve for primary reference fuels generally lies between Motor and Research octane number curves for other two fuel types.



High Requirement Cars

Needs of the 64 "high requirement" cars, based on the Research ratings of the three fuel types, are about equal, which means these cars rated the three fuels about alike.

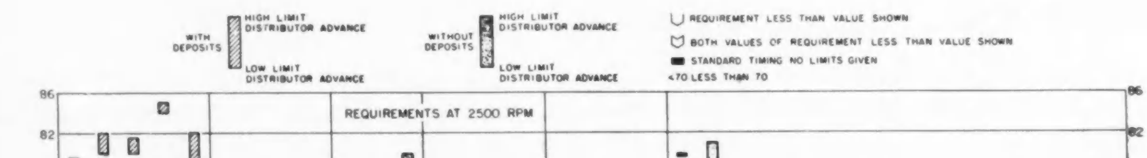


Tank Fuels

Each car was run with the fuel found in its tank to determine whether it knocked with that fuel. Test observers found 48% of the 260 cars knocked with tank fuel and that owners reported knock on 38% of the cars.

About 65% of the cars used regular gasoline, and of those, 54% knocked. Of the other 35% using premium grade gasoline, 35% knocked on tank fuel. (Excluded from these figures are 18 cars which mixed regular and premium grade gasolines.)

Charted here is the requirement distribution on the basis of grade of fuel used. At the 50% satisfied point, a four-octane number difference separated the distribution curves for the two car groups.



Effect of Ignition Timing

These antiknock requirement data for standard engines are given at the speed of maximum requirement and 1000 and 2500 rpm. They show that the spread in maximum octane number need, due to ignition timing variations within the manufacturers' distributor tolerances, is over 23 numbers—about that with over 90% of the 260 cars on the road tested. Effects of combustion chamber deposits also are shown.

Highlights of Today's ENGINE-FUEL PROBLEMS

EXCERPTS FROM PAPER* BY

V. G. Raviolo, Ford Motor Co.

* Paper "Some Aspects of the Engine-Fuel Problem Today," was presented at SAE Detroit Section, Oct. 4, 1950.

THERE is a tendency to look at the engine-fuel problem like the one of "Which came first, the chicken or the egg?" Engine development does not need to depend on fuel development, and by the same token it is not substitute for fuel development.

Mechanical and chemical octane numbers have sometimes been approached as if they were interchangeable. They never were and they cannot be substituted for each other. Chemical octane numbers are a measure of fuel utility—mechanical octane numbers are a measure of fuel utilization. There is a need for both and for the cumulative benefits to be derived.

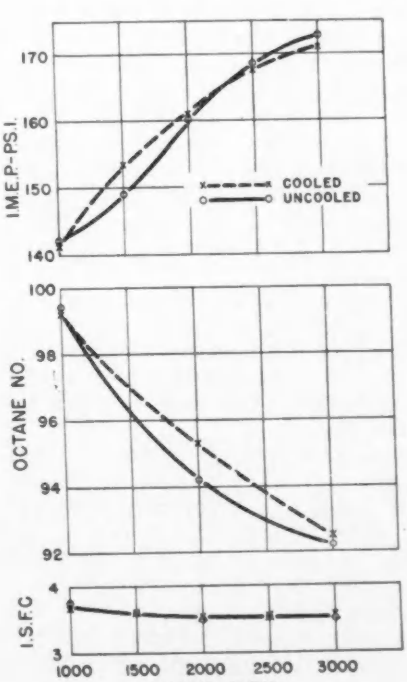


Fig. 1—Reducing exhaust valve temperature 600 to 700 F has little effect on imep, octane number, and indicated specific fuel consumption, these test data show. The test engine's compression ratio was 9 to 1

We have often heard engines discussed as if they had only two qualities, octane number requirement and compression ratio. There are some others:

1. The engine must be reliable before it can be of any value. You must be able to start it and keep it running under an extreme range of difficult conditions.

2. It must be economical in its use of fuels, its use of lubricants, and the repairs required.

3. It must be durable—give sufficient life so that the customer is satisfied.

4. It must be serviceable, so that the people in the field and the equipment available in the field are adequate for the maintenance of that engine.

5. It must be producible, with the machine tools, with the metallurgy, and with the manufacturing talents that exist today.

There has been a lot of publicity given to unconventional engines as a solution to the problem of fuel utilization. The proponents of these unconventional engines have some favorite assumptions. The first of these is that poppet valves are bad.

Now there are three things we expect a valve to do.

1. It must breathe adequately when it is open . . . pass the required quantity of gas without undue restriction.

2. It must seal when it is closed . . . seat tightly enough to hold compression.

3. It should have adequate mechanical life.

These things the poppet valve does well. However, the people dislike them because they are hot. The hot valve theoretically is supposed to heat up the charge and induce detonation and increase octane requirement.

Fortunately this has been examined experimentally by General Motors and reported by Floyd Wyczalek. To leave no doubt about the value of exhaust valve cooling in relation to mechanical octane num-

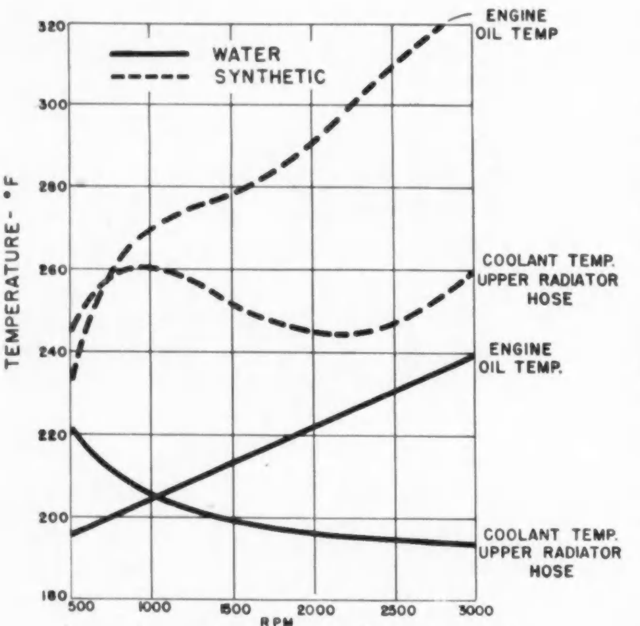


Fig. 2—Results from testing an L-head, V-8 engine with both water and synthetic coolant. Temperatures were controlled to temperatures obtained in the test car. Data are for maximum power with best spark

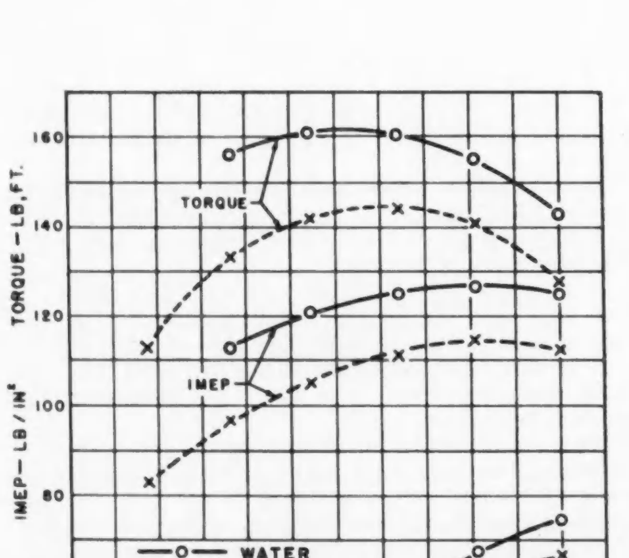


Fig. 3—Higher coolant temperatures reduce both torque and brake horsepower, several engines run on a dynamometer demonstrated

bers, a water-cooled exhaust valve was designed and built. This valve was installed on a single-cylinder overhead valve engine and run at 9 to 1 compression ratio. Water was fed through a port in the valve guide, down through the hollow stem, and out through four holes into the exhaust port. Tap water at 60 F was circulated through the valve at rates varying from zero to 60 lb per hr. This means the valve temperature was reduced 600 to 700 F at 1000 rpm.

The power and economy and octane requirement for both the water-cooled and uncooled valves are shown in Fig. 1. Under these equal power output conditions, there is no significant difference in requirement at any engine speed. The differences shown by these curves are within the limits of error of octane number requirement measurements. It is quite apparent from these data that cooling the exhaust valve does not result in a gain in mechanical octane numbers. This should dispose of the hot valve bogey once and for all.

On the other hand it has been suggested that our engines would operate more efficiently if the overall engine coolant temperature were increased. At Ford Research we investigated a synthetic coolant with a specific heat of 0.4 and compared it to water. Operating temperatures, shown in Fig. 2, were determined on the road. Oil temperature increased 50 to 80 F, coolant temperature increased 40 to 50 F. Carburetor air temperature was decreased approximately 20 F by blocking off the manifold heat.

Several engines were then run on the dynamometer, alternating both coolants, at these temperatures and performance was measured. The higher coolant temperature resulted in a decrease of both imep and hp, as shown in Fig. 3. The net result was a considerable loss of both bhp and torque over the whole speed range.

Fuel flow and spark advance were adjusted to the optimum for each temperature and speed (Fig. 4). Although the fuel flow was reduced with the high temperature coolant, there was a net loss of thermal efficiency. The difference is small. However, it is significant that there were no reversals.

Octane requirement was determined for two temperature conditions—the synthetic coolant at 210 F jacket temperature and water at 170 F. There was a difference in the maximum requirement of 13.5 octane numbers.

Another series of tests was run over a temperature range of 200 to 280 F. With the oil temperature controlled at 200 F, there was a constant decrease in ihp and bhp as temperatures increased, and there was a corresponding decrease of brake thermal efficiency. See Fig. 5.

The automobile companies do not need to speculate or theorize about unconventional engines. They have built them and measured their performance and they know the mechanical problems. There are isolated benefits in some of these engines; but up to now they have always been accompanied by corresponding disadvantages.

There is every reason to expect that there will be an accelerating development of conventional engines for the foreseeable future.

The problem remains, as it has been, to make the best possible use of available commercial gasoline in conventional engines.

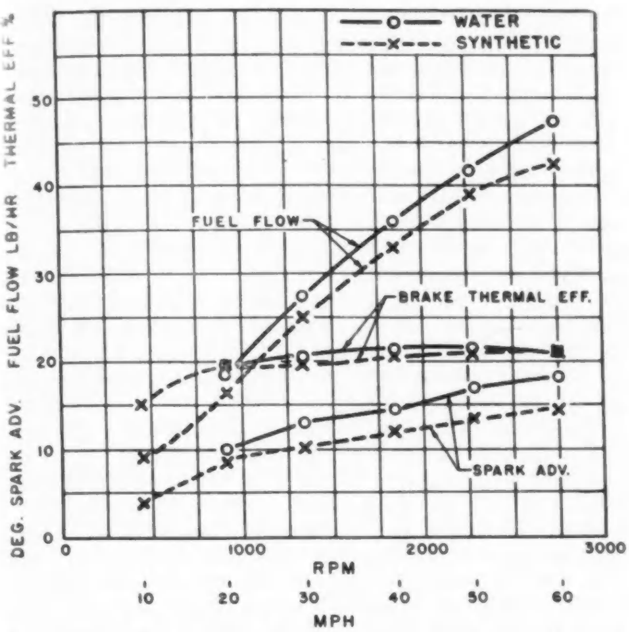


Fig. 4—Performance of L-head, V-8 engine with both synthetic coolant and water, with fuel flow and spark advance adjusted to optimum for each temperature and speed

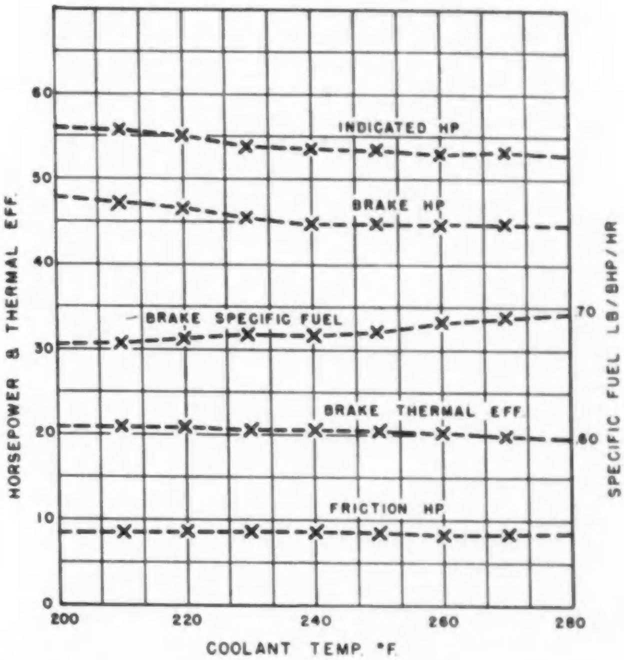


Fig. 5—Both indicated and brake horsepower decreased as coolant temperatures increased. These data are from tests with an L-head, V-8 engine, operating at 1600 rpm wide-open throttle, with oil temperature controlled at 200 F

The purpose of high compression ratio is improved fuel economy. It is interesting to see what we can afford to pay for increased economy. Miles per dollar of fuel increased steadily from 13 miles per dollar in 1920 to 32 miles per dollar in 1939. Fig. 6, taken from a paper presented by W. S. James, before the National Gas Association of America, shows the dollar value of improved fuel economy. If we assume a fuel cost of 30 miles per dollar, a 10% increase in mpg would save $30 in 10,000 miles. A 30% increase would save $80 in 10,000. It is obvious from this that any gain must be made at small initial cost to the consumer.

Economy, of course, is not the sole criterion of engine performance, any more than octane number is the only criterion of gasoline quality. An important property of fuel is the ability to burn clean. Combustion chamber deposits have been an increasing problem.

Fire engines, which are subject to periodic test of their pumping capacity by underwriters, furnish us with a continuing record from the pre-war period up to the present. We find that during this period combustion chamber deposits have doubled in the magnitude of their effect on the engine.

The torque loss on one of our standard production engines was measured on the dynamometer over a 60-hr deposit build-up period. At the end of this period there was a consistent loss of about 7.8% at all speeds. The torque loss of normal temperature operation was compared to the torque loss of relatively cold operation since this is the temperature range in which many vehicles operate. The loss measured under both conditions is about the same percentage after 30 hr.

Production engines were operated over the road on a fixed schedule, and the power was measured on the dynamometer before and after carbon removal. The torque loss after 10,000 miles was 11.7%. See Fig. 7.

The torque loss continues to increase with increasing mileage, as shown in Fig. 8. In each case engine power was measured on the dynamometer and the engine then continued to operate on the road for the next increment. There was a 6.6% loss from 2000 miles to 10,000 miles, and this loss increased to 15% at 20,000 miles.

Two vehicles were operated on identical schedules, one on leaded gasoline, one on unleaded gasoline. At the end of 10,000 miles the difference in torque was 11.4%. This test was repeated in 10,000 mile increments alternating vehicles on the two fuels, with identical results. Incidentally while the difference in economy is small, it is consistently in favor of the unleaded gasoline.

Power loss due to combustion chamber deposits has often been ascribed to the loss in volumetric efficiency due to the increased temperature of the inside of the combustion chamber. Power loss and air flow decrease were studied as a function of deposit weight. See Fig. 9. The percentage of power loss is substantially more than the percentage of airflow decrease; yet if this were purely a volumetric phenomenon the percentage would be equal.

The deposit areas were arbitrarily divided as follows: the valve chamber, the throat area, the quench area, the piston head, and the cylinder block. The distribution of these deposits was determined after a 61-hr build-up period. Deposits were carefully removed step-by-step and the effect of that removal was studied on the dynamometer (Fig. 10).

The solid line shows the percentage of deposit weight plotted against the percentage of total com-

bustion chamber surface. If the deposit were equally distributed, it would plot on the 45-deg line. The dot-and-dash line shows the percentage of air-flow recovery and the dotted line the corresponding percentage of power recovery. These tests show us that power recovery and air-flow recovery are directly proportional to deposit weight removal.

Of great interest to us was the fact that in several cases a trace of deposit, that is less than 3% of the total by weight, accounted for almost half of the torque loss. This trace deposit is that which occurs on the edge of the cylinder bore which is farthest from the valves. This leads us to suspect the lubricating oil and the oil additives.

It is interesting to note the effect of some fuel and lubricant variables as shown by Gibson[1]. The effect of base fuel type is shown by the fact that the special naphtha blend had approximately one-third of the increase in requirement indicated with the paraffinic oil.

The difference is even greater when naphthenic and paraffinic lubricating oils are compared. See Fig. 11. The naphthenic oil shows only a very small percentage of the increase in requirement indicated with the paraffinic oil.

We cannot yet explain all these effects, but we have these facts to face. A consistent 10 to 15% power loss, an increase in requirement of 6 to 10 octane numbers, and a 3 to 4% loss of economy cannot be overlooked.

Another fuel factor of major concern to the engine designer is fuel volatility or, more specifically, the distillation curve. This affects the start, the warm-up, the amount of manifold heat required, and the fuel distribution. The combination of automatic transmission and automatic choke makes the engine far more volatility-sensitive than it used to be.

The automatic transmission car will remain at rest only with a closed throttle; therefore, stalling or misfiring cannot be corrected by opening the throttle. A smooth and reliable idle under all conditions, from the moment the engine is started, is essential.

There are several ways that excessive volatility can cause the engine to stall. During the initial warm-up period, particularly when the air is moist and cold, the temperature drop that occurs in the carburetor due to fuel vaporization will result in the formation of ice crystals at the outlet of the idle jet. This is usually observed in the first three or four miles from the start.

This refrigerating effect can be minimized by applying some heat to the carburetor. However, it is obvious that after the warm-up is completed, this heat is unfavorable in that it tends to induce vapor lock or percolation in the carburetor jets.

The automatic choke is also volatility sensitive. It is a temperature responsive device for adjusting the fuel-air ratio to the manifold temperature, for a given distillation curve. Insufficient volatility will result in a failure to start. Excessive volatility will result in over-rich mixture and consequent stalling. The operator can, of course, override the choke by use of a full open throttle, to restart the engine.

[1] See SAE Quarterly Transactions, Vol. 3, October, 1949, pp. 557-570: "Factors Affecting Octane-Number Requirements," by H. J. Gibson.

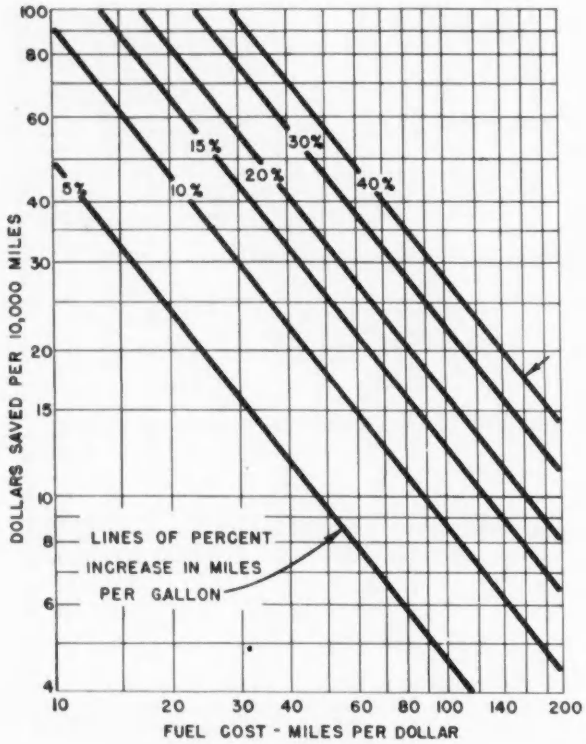


Fig. 6—What fuel savings mean in dollars

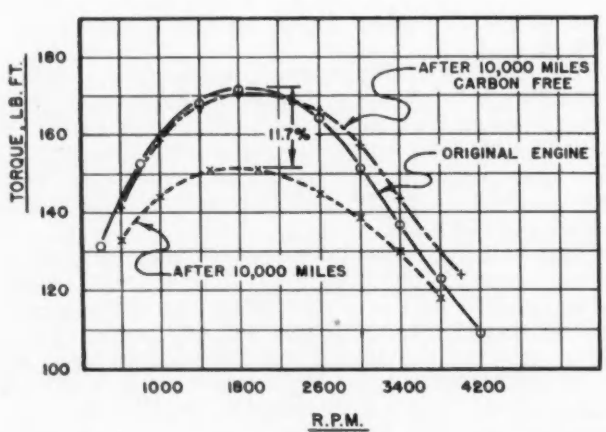


Fig. 7—Comparison of power of a Ford 8-cyl production engine before and after deposit removal

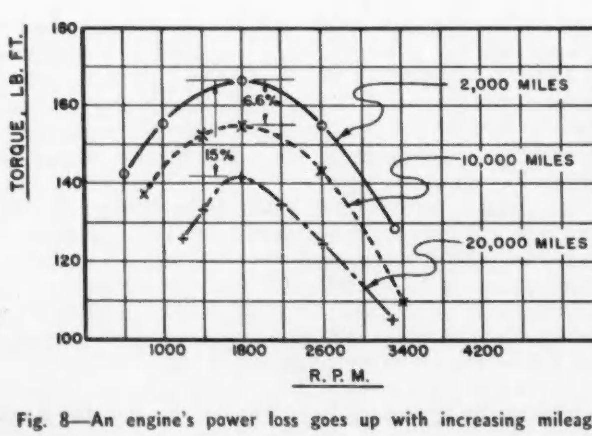


Fig. 8—An engine's power loss goes up with increasing mileage

The combination of automatic choke, excessively volatile fuel, and icing conditions brings about a peculiar failure wherein the engine fails to idle properly because of lean mixtures caused by the formation of ice in the idle jets. Subsequently, the engine stalls with the manifold cold and the choke in the closed position. Any attempt to restart the engine with less than full throttle results in overflooding or excessively rich mixture, with the same gasoline that caused the formation of ice and the lean mixture failure.

The distillation curve has a pronounced effect on the distribution within the intake manifold of the different fuel fractions. These fractions can vary in octane number enough so that some cylinders in the engine are supplied with low octane number fuel and some with high octane number fuel. The net result is to reduce the rating of the fuel in that engine to that of the poorer fraction.

Manifolds have been made of glass to permit the observation of the distribution of the mixture and of the liquid fuel. The uninitiated are always startled to see liquid fuel running along the upper walls and on the inside of bends in these manifolds. A heated area is usually provided in the intake manifold by means of a passage to the exhaust manifold to improve distribution by vaporizing this liquid fuel.

The difference in the volatility of fuel fractions leads to a difference in response to the heat supplied at this hot spot and, therefore, influences their distribution.

It is possible to develop a suitable automatic choke and manifold and carburetor combination for any reasonable commercial distillation curve. A given combination, however, will tolerate a relatively narrow range of volatility. As a result of the variation of environment, operating conditions, and type of fuel, manifold design and development continues to be the most exacting job which faces the engine designer.

I expect no startling or radical developments in the character of automotive engines. Poppet valves, crankshafts, and pistons will be with us until something decidedly better comes along. The industry-wide trend to overhead-valve engines has already become apparent and will probably continue. This will ultimately provide an opportunity for tailoring fuels to fit engines better as the character of their requirement curves becomes more similar.

Automatic transmissions will highlight the combustion chamber deposit problem because of their sensitivity to engine condition. They will also change the character of the octane requirement since they tend to increase the speed at which maximum rquirement occurs. A bulk of passenger cars and most trucks will continue to use either conventional or overdrive transmissions so that the present type of requirement will remain.

The commercial vehicle operator is becoming increasingly appreciative of the significance of octane numbers and compression ratio. Truck engine requirement will, therefore, tend to approach the upper levels of passenger car requirement.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

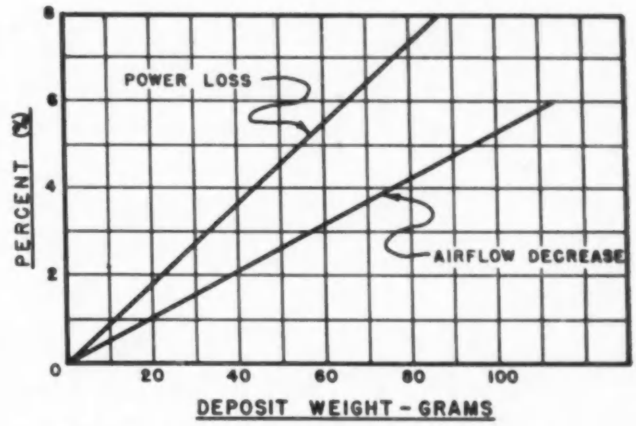


Fig. 9—As weight of deposits in an engine increase, both power and airflow decrease

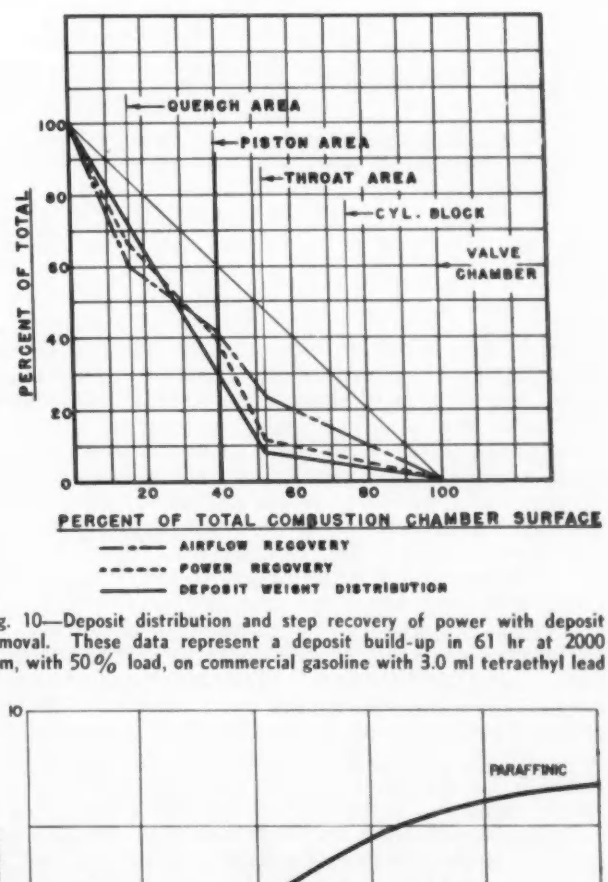


Fig. 10—Deposit distribution and step recovery of power with deposit removal. These data represent a deposit build-up in 61 hr at 2000 rpm, with 50% load, on commercial gasoline with 3.0 ml tetraethyl lead

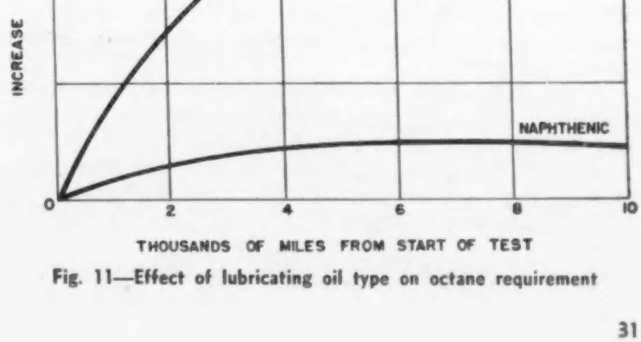


Fig. 11—Effect of lubricating oil type on octane requirement

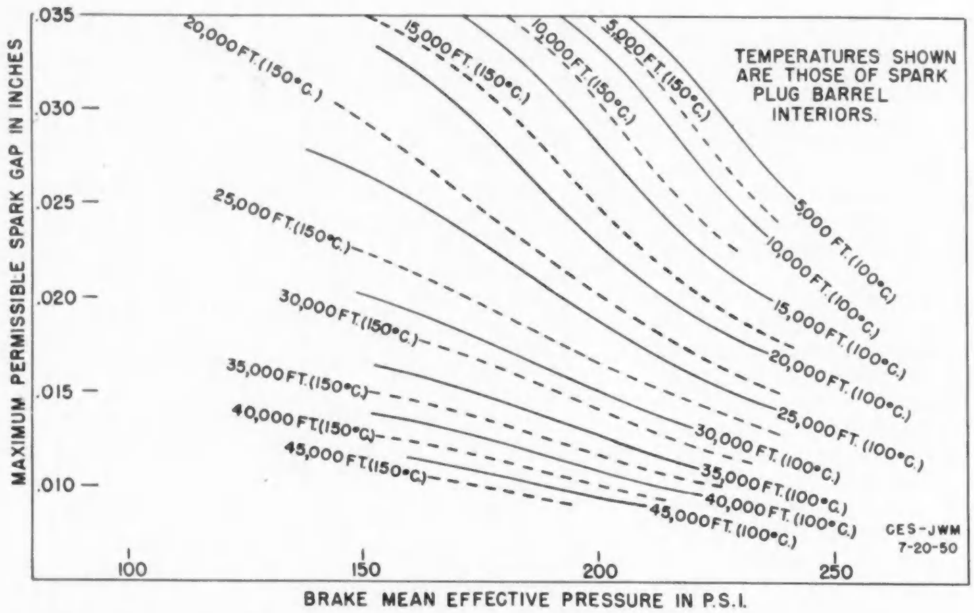


Fig. 1—The maximum permissible gaps for aircraft engine spark plugs under various operating conditions, charted here, were determined in a laboratory investigation

Tests

A four-step investigation and analysis has yielded conclusions regarding the maximum spark-plug gap that can be tolerated in aircraft operations, shown in Fig. 1.

Allowing spark-plug gaps to erode to larger dimension holds substantial savings for airlines by reducing the number of plugs overhauled for a given period of flying time. But as sparking gap increases, voltage required to fire the gap also increases. This places higher electrical stresses on the ignition generating and transmission system.

Available space in magnetos and continuity of insulating material in the cable to the spark plug have permitted designs that withstand voltages higher than the spark plug can transmit. Dimensional limitations of the spark plug itself, coupled with the necessity for a connection to the cable, have limited the voltage that can be transmitted to the spark gap.

Objective of this investigation was to find the maximum permissible spark-plug gap that can be fired by voltages transmitted through this critical region—the spark-plug barrel.

Four steps in the investigation were:

1. To find a way to simulate engine operating conditions in the laboratory which would correlate spark-plug bomb pressures with various conditions of engine power.
2. To determine sparking voltages required to fire various gaps at different bomb pressures corresponding to various engine power configurations.
3. To determine experimentally the breakdown voltage for various spark-plug barrel configurations and, if possible, to express this relationship analytically.
4. To construct a set of curves assembling the information of the first three steps into a directly usable form.

To get the correlation between engine power and bomb pressure, a spark plug was placed in a bomb and wired in parallel with a plug in an engine. With a given engine power setting, the CO_2 pressure was gradually lowered until the first spark fired in the bomb. The CO_2 pressure was then lowered still further until the sparking was quite regular in the bomb and then raised until all sparks in the bomb were extinguished. The pressure at which the first spark occurred and the pressure at which the sparks were extinguished were recorded.

A spark in the bomb was detected by means of a neon lamp in parallel with a 3000-ohm resistor, the combination being inserted in the ground path for the bomb. This method of detection was previously tried in the laboratory and proved satisfactory if the resistance was of a large enough value to eliminate interference from other plugs firing in the same vicinity.

A window was placed in the bomb to permit a

TABLE I

RPM	MAP	Torque (bmep ÷ 1.79)	Mixture
2100	34	81	Rich
2100	34	81	Lean
2270	36.5	93	Rich
2270	36.5	93	Lean
2500	45	110	Rich
2500	45	110	Lean
2590	48.5	118	Rich
2680	50	Max. (126)	Rich-Wet

Reveal Best Gaps For Aircraft Spark Plugs

EXCERPTS FROM PAPER* BY

C. E. Swanson and J. W. Miller, Northwest Airlines, Inc.

* Paper "How Large Can the Gaps Be?" was presented by title at SAE Annual Meeting, Detroit, Jan. 8, 1951.

visual check on the indicator when it was installed on the engine test stand. The check proved satisfactory; but the window could not be used throughout the test because of its proximity to the propeller.

The engine used was a Pratt & Whitney R2800-CA18 equipped with water injection. The operating conditions used were held as closely as possible to those in Table I.

Lower power settings were tried. But the results were too erratic to use and not of enough importance to continue running.

Matched sets of plugs with gaps ranging from 0.010 to 0.045 in. were used for the test. The gaps for these pairs were eroded to the proper width and the two plugs fired in the same bomb and from the same source of voltage until they would fire alter-

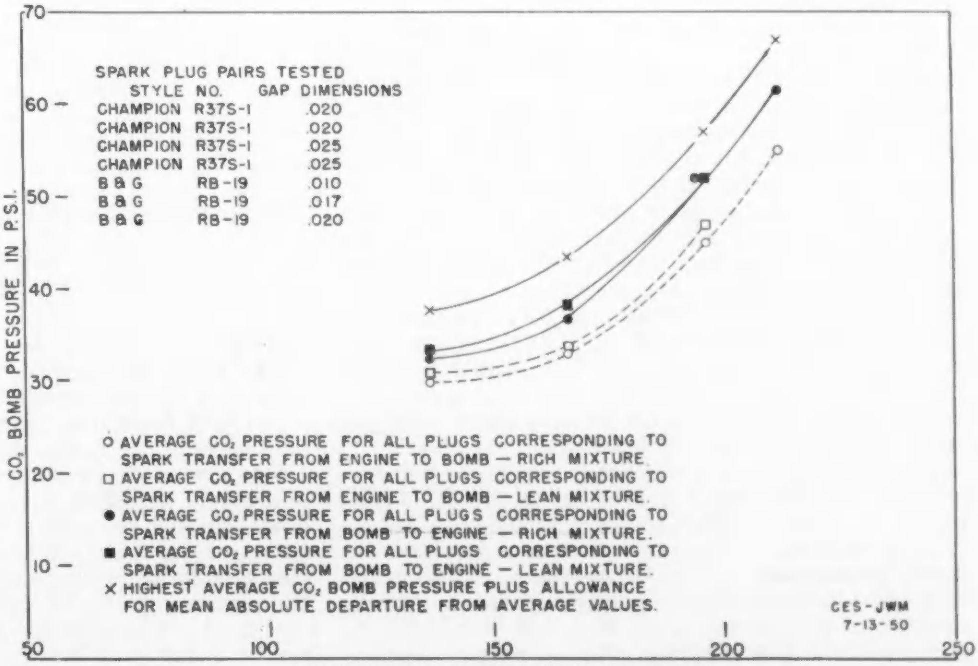


Fig. 2—Shown here are the CO_2 bomb pressure equivalents of engine power configurations. The engine in this case was a Pratt & Whitney R-2800-CA18

nately through a range of air pressures from 0 to 95 psi.

Results of this part of the test are plotted in Fig. 2.

Differences between the sparking characteristics of the engine charge and CO_2, and differences in temperature of the electrodes, make a detailed analysis of the general curves difficult. Equivalent CO_2 pressures would, however, be expected to rise with bmep at an increasing rate because the rapidly increasing friction losses require a larger than proportionate charge. The upward concavity of the curves in Fig. 2 show this trend.

In plotting the curves, averages of all readings were used. The large number of readings taken and the resultant smooth curve of averages serve to give assurance that the influence of experimental errors has been reduced to relative insignificance.

However, because of the large departures of the individual readings from the averages, these departures being attributable to inherent characteristics of the reciprocating engine more than to experimental errors, it was decided to use the highest average values plus the mean absolute departure from the averages as the spark-plug bomb pressures for determining maximum permissible gaps. Very few points actually lie above this curve.

It is interesting to note that the equivalent bomb pressures are very little higher for lean mixtures than for rich mixtures, although a difference definitely exists.

The equipment used to accomplish the second step of obtaining curves of sparking voltage versus CO_2 bomb pressure for various spark plugs and gaps, consisted of a variable 60 cycle a-c supply connected to a spark plug in a CO_2 bomb. The bomb had a glass window to observe the spark.

The spark plugs used were Bendix Type 7KLS-2 and Champion Type R37S-1. The R37S-1 gaps were eroded to desired dimensions by actual service in a P&W R-2000 engine. The 7KLS plug gaps were eroded to dimension by fast cycle sparking in the laboratory.

The procedure used to conduct the test was to set a given pressure of CO_2 in the bomb and raise the voltage until it fired the gap in the plug continuously, or nearly continuously. The tests on the Bendix 7KLS-2 plugs were run at Northwest Airlines, Inc. in 1941, and the tests on the Champion R37S-1 plugs were run at Northwest Airlines, Inc. in 1950.

Results of the two tests are plotted in Fig. 3.

Despite the very considerable differences in the construction of the two types of plugs, the voltages required to fire equal gaps are practically identical. Several other curves of Champion R37S-1 plugs were run at gaps between 0.025 and 0.035 in. and the curves fell almost exactly in their proper place as interpolated between these curves. It is quite difficult to get an exact measurement of spark plug gap with errors not exceeding 0.001 in.

Inspection of the curves of Fig. 3 seems to indicate that an error was made in measuring the gap designated as 0.030 in. Probably a dimension of about 0.029 in. existed. A fine wire plug was also tested in a similar manner, but a lesser degree of accuracy existed in determining the gap dimensions. Ninety percent of the points taken had less than 5% departure from these curves. These results lead to the conclusion that sparking voltages for a given CO_2 pressure are primarily a function of gap dimension, and that existing differences in spark plug electrode construction do not change it appreciably.

The family of curves of Fig. 3 clearly show that the potential gradient required to produce spark-over increases as the gap spacing is reduced.

The third step of comparing barrel breakdown voltage versus air density was accomplished with test equipment consisting of a voltage supply and current indicator, a vacuum pump and gage, and spark plugs with the electrodes cut away. A high air pressure was held in the bomb to make certain sparks were suppressed at the electrode end of the plug, even though the electrodes were removed.

The procedure used was to set a given barrel pressure and raise the voltage until the neon lamp flashed at intervals of less than 5 sec. This procedure was checked by looking into the interior of glass insulated barrels to make sure that a flash of the neon lamp did indicate a flash-over in the barrel. Barrel pressure readings were taken in inches of mercury and the air density ratios were computed by dividing the absolute pressures obtained by the standard absolute air pressure.

The temperature throughout the test was not controlled, but room temperature did not vary appreciably during the tests. Cable and insulators were changed with the same spark plugs to get a comparison of 5-mm and 7-mm cable and of different type insulators.

Equivalent altitudes with a constant barrel temperature were calculated by the following equation:

$$\delta = \frac{P\ T_0}{P_0\ T} \qquad (1)$$

where: δ = Air density ratio at altitude in question.

P = Standard air pressure at altitude in question in inches of hg.

P_0 = Standard air pressure (29.92 in. Hg) at sea level.

T = Temperature existing in spark-plug barrel in degrees K.

T_0 = Standard air temperature (15 C or 288 K) at sea level.

For a constant barrel temperature of 100C

$$\delta\ 100C = \frac{288P}{373 \times 29.92} = 0.0258P \qquad (2)$$

Results of this test are plotted in Fig. 4.

The final results of the step of applying the information previously obtained to the actual determination of the maximum permissible spark plug gap are presented in the family of curves appearing in Fig. 1.

To develop this family of curves, a given altitude and barrel temperature were chosen and the breakdown voltage corresponding to the air density determined by them was taken from Fig. 4. Applying this breakdown voltage to Fig. 3, maximum permissible spark gaps for various bomb pressures were determined. These bomb pressures were then converted to bmep by Fig. 2 and the results plotted.

This procedure was repeated for various altitudes

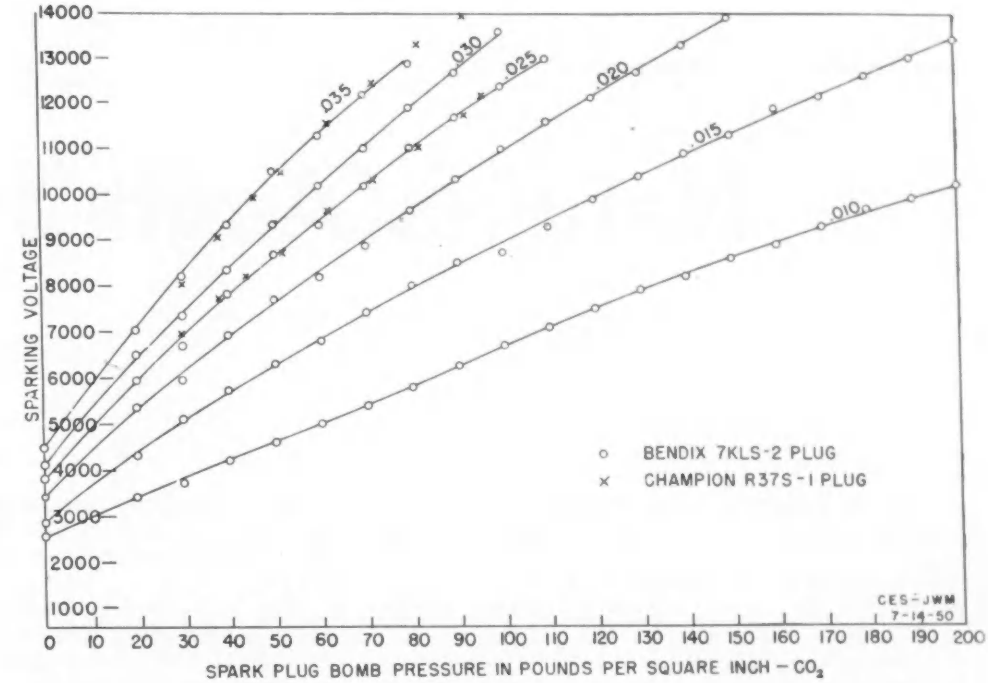


Fig. 3—One phase of the investigation disclosed sparking voltage against CO_2 bomb pressure for various spark plugs and gaps

and barrel temperatures. Since exact temperatures existing in spark plug barrels were not known, curves for 100 C and 150 C were plotted.

Interpolation can be employed to ascertain the maximum permissible gap for spark plugs having barrels operating at intermediate temperatures. If necessary, additional curves can be plotted using the procedure described.

If supercharged harnesses are employed, the altitude curve to be applied would be the one having a standard atmospheric pressure equal to the actual pressure existing in the spark plug barrel.

The inflection of these curves, from concavity upwards to concavity downwards as bmep is reduced, is attributable to the diminishing slope of the curve of Fig. 2 in the corresponding region of bmep.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Fig. 4—Before determining maximum permissible spark-plug gaps, it was necessary to find breakdown voltages for various spark-plug barrel configurations and air density ratios

Nation's Airlift Studied

MILITARY AIRLIFT is now regarded in this country as a must and accorded five basic missions:

1. Transport of personnel
2. Transport of heavy equipment in emergencies
3. Transport of packaged cargo
4. Evacuation of wounded
5. Aerial resupply

The huge new transports designed specially for heavy-duty military use can do all five jobs and do them well. But in time of war, their numbers must be supplemented by the fleets of a healthy commercial air cargo industry, able to serve both military and nonmilitary shippers. And one way to keep the commercial air cargo industry healthy is to cut terminal handling costs by using mechanized equipment.

This was the picture that developed at the second annual Air Cargo Day, November 28, again sponsored jointly by the ASME Aviation and Materials Handling Divisions, the Institute of the Aeronautical Sciences, and the SAE as part of the Annual Meeting of the ASME. General Chairman Robert B. Lee and his helpers assembled a program of seven speakers. George Hayes secured exhibits of airplanes, helicopters, and cargo-handling equipment for an Air Cargo Display. Nearly 300 attended the afternoon-and-evening event.

Civilian air-cargo operators, airplane manufacturers, and materials-handling experts far outnumbered the U. S. Air Force, Navy, and Army officers and Canadian military men present. But during the sessions, tabloids headlined "NEW WAR" appeared on the newstands outside New York's Hotel Statler. Inside, Air Cargo Day participants fastened their attention on military air-cargo needs.

Airlift was absolutely essential to the first five months of the Korean struggle, an observer of the fighting there explained, because rail, highway, and water transportation possibilities were almost nil. United Nations bombers devastated the Pyongyang railroad yards, heart of the small Korean rail system, early in the campaign. Korean roads are few and inadequate. And the two harbors the Navy had counted on for landing supplies turned out to be shallow, strewn with mines at their entrances, and subject to very rough seas. Korean airfields leave much to be desired, but at least United Nations air transport activities were little hampered by enemy air power. So airlift was used to move men and materials to a greater extent than ever before.

The Military Air Transport Service flew troops from Tacoma to Tokyo in 35 hr and on to Korea in a total of less than 5 days. MATS also airlifted into Korea in C-119's such items as a 600-ton permanent-installation bridge, a 400-ton pontoon bridge, an asphalt paving unit, and a crash truck, besides thousands of tons of more routine cargo in C-119's and other aircraft.

On their return trips, MATS airplanes brought out the wounded. Air evacuation was credited with helping to cut the mortality among the wounded from the 4% rate prevailing during World War II to 1%. Through air evacuation, wounded men get better medical care sooner—and the knowledge that they will get it quickly is a strong psychological factor in recovery.

Although MATS C-119 Fairchild Packets flew almost directly from factory to front lines, they drew praise for their lack of service troubles. Only difficulties so far have been with runaway propellers and a general scarcity of spare parts and maintenance personnel.

Out of the C-119 has grown the XC-120 Fairchild pack-carrier airplane. An Air Materiel Command spokesman explained that this design has been built primarily to study the pack principle. The idea is that the expensive power unit can detach the relatively inexpensive cargo unit, pick up another loaded cargo unit, and be off without waiting for unloading. Ultimately, it may even be possible to design the cargo unit for over-the-road haulage by truck-tractors, it was suggested.

The principle was exemplified also in the new Piasecki pod-lifting helicopter shown in sketches forming part of the Air Cargo Display.

A proponent of the C-124 Douglas Globemaster countered with another proposition: Design the airplane fuselage to accommodate pack capsules such as truck trailers and flat-car tanks. Then the airplane need not be compromised aerodynamically nor the ground vehicle structurally. He showed that the C-124 is big enough and strong enough to take a railroad tank car, although he doesn't expect to see it practiced. A more likely load is three fully loaded 6 × 6 trucks.

at Air Cargo Day

The C-124 can operate at a gross weight of 194,500 lb or better, he said, and can carry 50,000 lb of payload over an 850-mile radius. It can transport 200 fully equipped paratroopers, or it can evacuate 127 litter patients plus 25 attendants or ambulatory patients. It can load B-36 propellers, tail surfaces, and wing panels. Its 136 × 140-in. doors are large enough to admit without disassembly 94% of current-design military ground vehicles, even the largest earthmoving equipment and radar trailers.

The C-124 incorporates so much loading equipment that loading and unloading requires specialists, one of its designers warned.

Two other new transports, the Boeing C-97 Stratofreighter and the DC-6A Douglas Liftmaster, were discussed.

Veterans of World War II flights in bucket seats rejoiced that for personnel-transport duty the C-97 provides new-type canvas seats, said to be much more comfortable. The C-97 represents a compromise in the old argument of truck-bed-level door sills for ease of loading packaged cargo versus higher door sills for better structural efficiency. About 30% of the cargo volume can be loaded through doors with sills 4 ft above ground level. Doors to the remainder of the cargo volume are 9 ft above ground level. Penalty for the low-door design was estimated as about a 1½–3% loss in payload.

The C-97 was designed to take heavy equipment, too. The flooring is strong enough to take concentrated loads of 8 tons in some areas. Four Red Cross ambulances have been transported, then discharged in as little as 2½ min under their own power.

It takes only a few hours to stow the sturdy tie-down fittings used for heavy-equipment cargos and set up litter fittings for evacuating wounded. Provision is made for electric blankets, and pressurization adds to patients' comfort and safety.

Claims were made that as an aerial resupply airplane, the C-97 can drop 25,500 lb of specially packaged cargo in a 150 × 2500 ft area in 12 sec—all at the push of one release button. The packages are suspended from 17 hooks riding an overhead rail. Tie-down attachments steady the burden of each hook. When the release button is pushed, the tie-down fittings disengage and a pulley arrangement draws the hooks to the opened exit at the rear of the airplane where they detach their loads. Airplane balance is maintained automatically during the dumping operation. Pilots were quoted as saying that they notice no change in balance as the cargo leaves.

The restricted landing area of the dropped cargo is expected to make recovery surer. With World War II methods of aerial resupply, sometimes only 10% of the dropped cargo was useful to ground forces, it was recalled.

Big advantage seen to the DC-6A Douglas Liftmaster is that it could very quickly be put into large-scale production. Tooling and experience acquired during production of the DC-6 passenger transport can be applied to much of the DC-6A. Enough DC-6A orders have been received to develop mass-production techniques for those items not common to passenger aircraft. Each DC-6A represents an airlift potential equal to two C-54's, according to one estimate.

Commercial and military operators agreed that their equipment should be interchangeable—that is, that there should be similarity in both design and operating procedures wherever possible. Both generalized that they need safety, low-operating-cost, big doors, strong floors, and pressurization for the crew.

Military experts stressed that cargo must be fastened so securely that it won't drive forward to crush crew and passengers in any survivable crash. Tie-down fittings should be distributed liberally about the cargo area, but each should be strong enough so that only a few are required to secure the heaviest cargo unit. This saves handling time and avoids progressive failures. As a further safety measure, one officer asked for stronger nose frames to protect crews in case of crashes.

Both military and commercial operators indicated that they will be content with reciprocating engines for the foreseeable future, although airplane manufacturers talked of the performance gains possible with use of turbine powerplants. When it came to turbines, one military man expressed preference for turboprops because reversible-pitch propellers can cut requirements for landing-run length. The field is never big enough in emergency operations, he remarked.

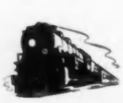
Although the military men seemed to prefer big

Continued on Page 47

WITHOUT its detachable fuselage, the Fairchild XC-120 is like a truck-tractor without a trailer, and is aerodynamically stable

TRUCK–TRAILERS

New Use of Old Idea

Detaching the load-carrying element from the prime-moving element goes back to man's use of horses or oxen to pull a wagon.  Functional farm implements for tilling, sowing, and harvesting  are all detachable from the farm tractor. This method of achieving flexibility and economy also is exemplified by the barge, which transports trains of loaded freight cars, and its prime mover, the tug.  And where would we be if railroad freight cars were not detachable from the locomotive?  On the highway, the truck tractor-trailer combination  shoulders much of this country's transportation load. The detachable fuselage is nothing more than an extension of the same principle, proved feasible on the ground and on water, to vehicles of the air. 

WITH its cargo pod attached, the "Pack Plane" is winging toward its destination, where it can discharge both load and fuselage

TAKE TO THE SKY

BASED ON PAPER* BY

G. W. Lescher and J. A. Sterhardt

Fairchild Aircraft Division, Fairchild Engine & Airplane Co.

* Paper "A Concrete Phase in the Development of the Load Detachabiilty Principle in Aircraft," was presented at SAE Metropolitan Section, New York, Nov. 2, 1950.

THE load-detachability principle achieved in Fairchild's XC-120—an airplane with detachable fuselage—opens new vistas to both civil and military air transport. But this aircraft brought new design challenges, such as the four-wheel landing gear and hoisting and securing the load-carrying pack to the carrier.

In the commercial direction, load detachability probably will find its greatest field in bulk moving of goods or materials with the pack, like tractor-trailers. It will serve not only as the containing element for loading and unloading in transit, but also for temporary storage at terminals.

This will reduce the number of warehouse installations required at terminals, ease congestion in aircraft parking facilities at airports, and eliminate tie-up of the prime mover which is required only for transit purposes.

The pack may be made adaptable for long-distance transport by air carrier and for transit to local destination by tractor-trailer. This could be done with a standardized trailer chassis made specifically to accommodate the pack. For more specialized purposes, the pack may be designed to have its own means of roadability and mobility for local surface operation.

The detachable fuselage also can perform the military equivalent of commercial functions. It can encompass a broad range of tactical utility too. This goes beyond the mere transportation of troops, heavy military vehicles, armament, ammunition engines, spare parts, and even light tanks with standardized cargo packs.

Specialized packs, with or without built-in roadability, can be provided as part of the detachable transport system. Such specialized pack units may be pre-equipped as advance field headquarters, emergency field hospitals, field intelligence centers, machine shops, advance testing laboratories, weather stations, radio stations, mobile housing, and so on. See Fig. 1. Special fuel or oil-carrying tank packs also may be used for emergencies.

Fig. 1—The detachable fuselage has lots of potential in military operations. Pack units may be designed as emergency field hospitals, machine shops, and other portable self-contained installations, readily delivered to desired location by aircraft and just as quickly removed when necessary

Another interesting military application is dropping entire loaded packs while in flight for assault purposes. Not insurmountable are technical problems of maintaining stability and level altitude of the pack during descent, in controlled deceleration near the ground, and shock absorption upon ground contact.

Skidding assault packs onto prepared fields, with the carrier continuing in flight after detachment, has been seriously mentioned. Jettisoning troop-loaded assault water-planing packs from just above water, headed toward beach-heads under attack, also may be less fantastic than at first blush.

Whatever the military applications, the packs can be made of nonstrategic materials, produced relatively cheaply, and are highly adaptable to volume production. They could be considered expendable. In case of successful enemy attack on one of our advanced bases, this becomes a significant feature. It is better that cargo-carrying equipment, parked or being loaded and unloaded there at the time, consist mostly of expendable cargo packs than of inexpendable whole airplanes. Extensive use of detachable packs also would relieve crowded facilities of such airheads.

The carrier may be used without packs for carrying exceptional items such as poles or beams. Cradles or racks attached to standard carrier attachment points could be used in place of packs.

New Design Problems

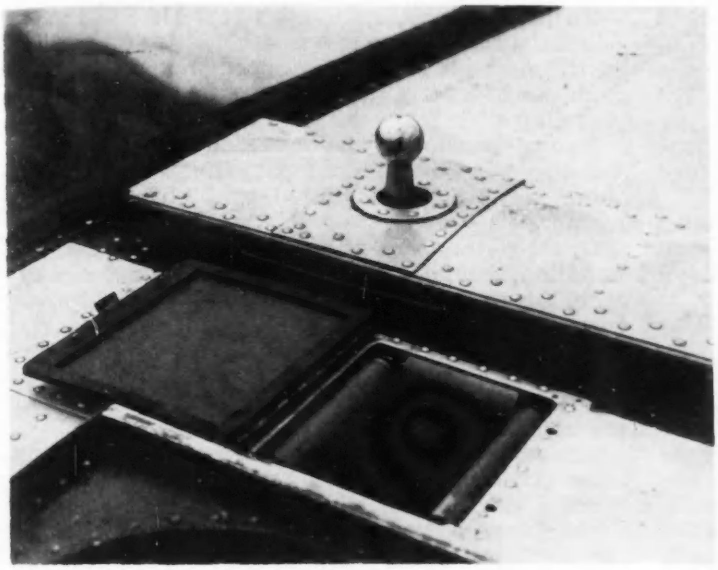
The Fairchild XC-120 is proof positive that the challenge of a detachable fuselage airplane can be met. The experimental "workhouse" design consists of a C-119 center wing with minor modification, to which a crew nacelle is attached. Engines and booms remained the same distance from the centerline, but the engines were moved forward 4 ft. Many C-119B components were used unchanged for design and manufacturing economy. But this penalized design and load-carrying efficiencies somewhat. See Table 1 for some of the airplane's general specifications.

The four-wheel landing gear and the fittings for locking pack of airplane posed unique problems.

Final landing gear designed consisted of C-119 main gears and a new nose wheel gear supported by steel tube structures forward of each firewall. It was possible to get short wheelbase of about 15½ ft. But this called for a thorough study of airplane dynamics during landing to find wheel and shock strut reactions. The main wheels were located as close as practicable to the airplane's center of gravity. Minimum propeller plane clearance determined nose wheel location.

The structure supporting the nose wheel became a serious problem because of its somewhat cantilever type suspension. A steel tube structure attached to the engine mount minimized deflections. The nose wheel is the levered suspension type with castering wheels and hydraulic shock absorbers.

The quadricycle gear offers an unusual steering problem. The inner nose wheel turns at a greater angle than the outer one. Mechanical interconnect between the nose wheels proved impractical, so we turned to hydraulic steering. But early ground tests showed the airplane's ground handling to be excel-



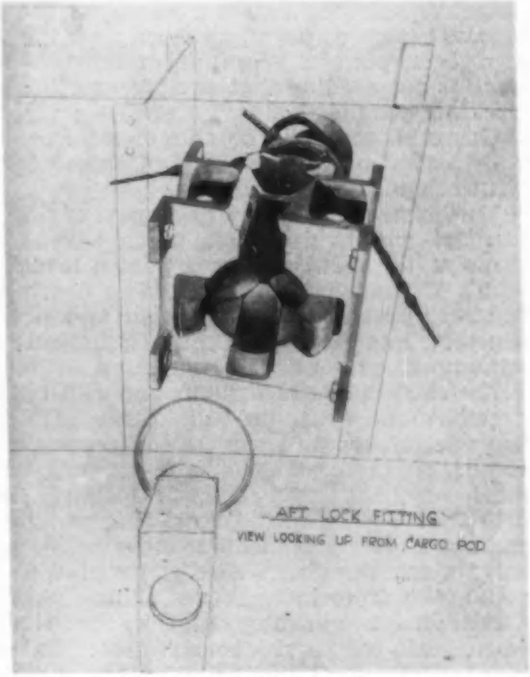


Fig. 2—The pack is locked to the crew nacelle of the Fairchild XC-120 by a ball and orange-peel type joint. The ball, at left, is attached to top of pack, and the jaws, at right, to bottom of carrier structure. There are four such fittings

lent without a steering system, so that it is not now used.

The fittings problem was unusual because of the many variables involved. The locks had to be positive, self-locking when the pack was hoisted into place, and easily disengaged; all four fittings had to be released simultaneously; provisions had to be made for manufacturing misalignment and mislocation due to unequal hoisting. A ball and orange-peel type joint, Fig. 2, provides the flexibility, load-carrying capacity, and easy release.

There is a 2-in. gap between pack and crew nacelle when the two are attached—the permissible minimum for misalignment and deflection in flight. Both the crew nacelle underside and pack top are flat surfaces. The ball portions of the four lock fittings are attached to the structural members on the pack top. The jaws and release mechanism of the lock fittings are located on the bottom of the carrier structure.

Cables interconnect all four fittings, with chains over the sprockets at each fitting. A lock control lever, convenient to the crew-chief's station, operates the cable. This control lever has three positively held positions: locked, armed, and release.

Moving the lever into "release" position simultaneously releases all four lock fittings. To prepare the lock fitting jaws for re-engagement of the balls, the lever must be moved into "armed" position.

Four individual cable and drum hoists lift the pack in place. The hoists are positioned at the same fore and aft stations as the lock fittings so as to use the same heavy structural members for supporting the hoists and locks. Hoists are designed for hoisting an overall cargo and pack weight of 25,000 lb. The auxiliary powerplant and its generator provide current for hoisting. Fig. 3 shows the hoist arrangement.

A portable master switch box controls lifting or lowering of the pack. This control box has four individual push-button type switches to operate each hoist. One master switch controls the up or down operation. All four hoists may be simultaneously operated with the master hoist switch.

The master switch box is energized only after all four hoisting cables are attached to their respective hooks on the pack and at least 500 lb tension is put on each cable. This safety feature prevents inadvertent hoisting of the pack with one or more cables not properly attached to the hooks.

The cables may be lowered or raised by individual

Table 1—General Specifications of the Fairchild XC-120

Normal Gross Weight	64,000 lb
High Speed—Pack Off	above 250 mph
High Speed—Pack On	above 230 mph
Wing Area	1447 sq ft
Span	109 ft
Length	83 ft
Height	24 ft 10 in.
Engines—2 Pratt & Whitney R-4360-20	
Rated at Take-off	3250 hp
Normal Crew	5
Pack Dimensions	
Overall Length	56 ft
Length of Cargo Space	37 ft
Width of Cargo Space at Floor Level	9 ft 2 in.
Height of Cargo Space	8 ft
Volume	2700 cu ft
Floor Area	353 sq ft
Design Capacity of Cargo Hold	20,000 lb
Clearance from Ground to Bottom of Crew Nacelle—Pack Off	12 ft 6 in.

switches near the hoisting hooks on the pack. A bypass switch on the flight deck, near the lock control lever, permits operation of the hoists when a pack is not used so that equipment other than the pack may be hoisted.

One crew man will be able to raise or lower the fully loaded pack, since 35 ft of cable are provided with the portable switch box.

The pack, the cargo-carrying part of the airplane, is a self-contained movable unit. Large clam shell doors at the front and back permit loading to full width of the pack, over 9 ft. The flooring and its supporting structure is designed and equipped to accommodate heavy military equipment, such as light tanks, armored cars, and guns.

The clear height of 7 ft 8 in. and width of 9 ft 2 in. provide ample space for bulky cargo. Tie-down fittings accommodate troop seat supports, litter stanchions, engine cradle ties, and other heavy equipment requiring high-strength fittings. A fitting near the front end of the cargo floor permits attachment of a block and tackle to move heavy and bulky cargo along the floor. Skid strips prevent damage to flooring from heavy boxes sliding on the floor.

There are two loading ramps so that vehicles can be run into the cargo compartment. These ramps may be attached to either the front or back openings of the pack. They may be adjusted to accommodate the tread width of various vehicles.

A hatch in the roof of the pack and another in the floor of the crew nacelle, aligned with each other, permit normal entrance and exit with the pack attached.

Ground mobility of the pack introduced a new type problem. The pack, basically an aircraft structure designed for flight loads, did not readily adapt itself to ground loads.

To use the maximum number of C-119 parts in the one XC-120 airplane, it was decided to limit utility of the first pack. Towing speed was limited to 5 mph and the terrain to relatively smooth runways and ramps.

Future packs can be designed for high-speed hauling on main or secondary highways. Size of these packs may be limited by highway requirements.

By restricting pack utility, requirements of ground handling gear also were simplified. Four easily detachable, dual-wheel gears are provided for ground handling.

Service and maintenance provisions also presented a tough problem. Fact that bottom of the crew nacelle was 12 ft above the ground made use of movable stands mandatory at major bases.

Sometimes airplanes must be serviced at remote bases not equipped with movable stands. The collapsible service ladder, always carried in the crew nacelle, may be used for servicing certain parts of the airplane.

The XC-120 is an experiment or exploration, not intended as a solution to practical problems, but only as a tool to find the real problems of the load detachability principle.

This is the first major step in separating the cargo container from the carrier in aircraft. We hope this development will initiate a new trend in cargo hauling by air. Information obtained from testing this airplane is expected to accelerate further development of the basic air trailer concept.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

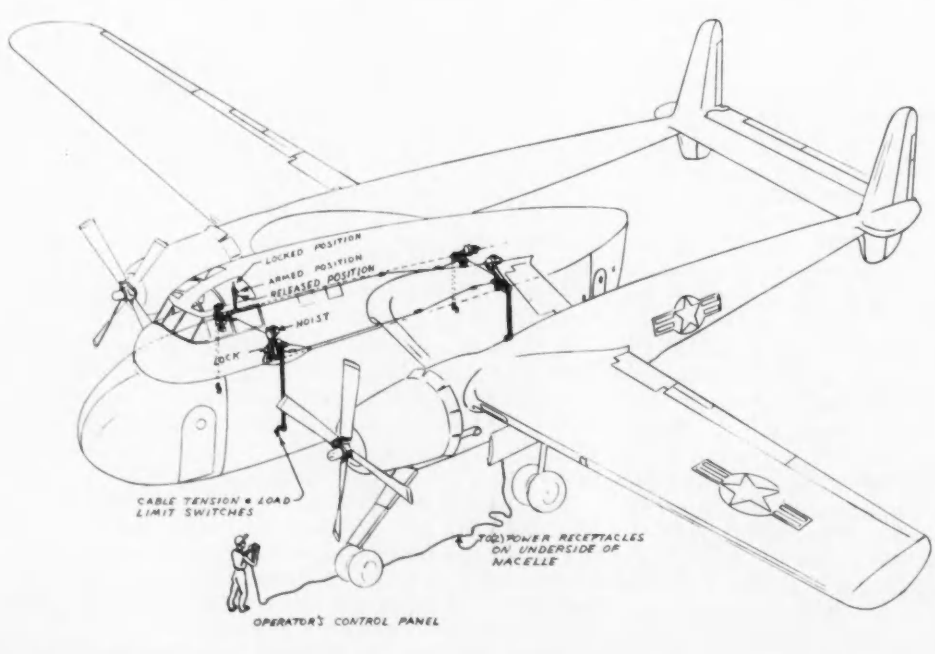


Fig. 3—Location of equipment for hoisting pack into position so that it may be attached to carrier structure of the Fairchild XC-120. One man can raise or lower the fully loaded pack

EXCERPTS FROM PAPER* BY

B. F. Morrell and N. F. Frischhertz

Aircraft Gas Turbine Division, General Electric Co.

* Paper "Development of the Anti-Icing System for the J-47 Gas Turbine," was presented at the SAE National Aeronautic Meeting, Los Angeles, Sept. 28, 1950.

ICE-PROOFING The J-47 TURBOJET

THE J-47 gas turbine gets complete anti-icing protection from a system consisting of a retractable screen and air-heated inlet guide vanes, island fairings and struts, and accessory nose cowl. See Fig. 1. This anti-icing system has transformed the turbojet from a "fair weather" to an "all weather" engine, as shown by both ground and flight tests.

The air inlet screen is the part most susceptible to icing because of its high collection efficiency. Protecting the screen or eliminating it as a potential icing hazard probably is the toughest problem to solve. Simplest method of preventing ice collection would be to eliminate the screen altogether. But possibility of damage from foreign particles getting into the compressor prevents that.

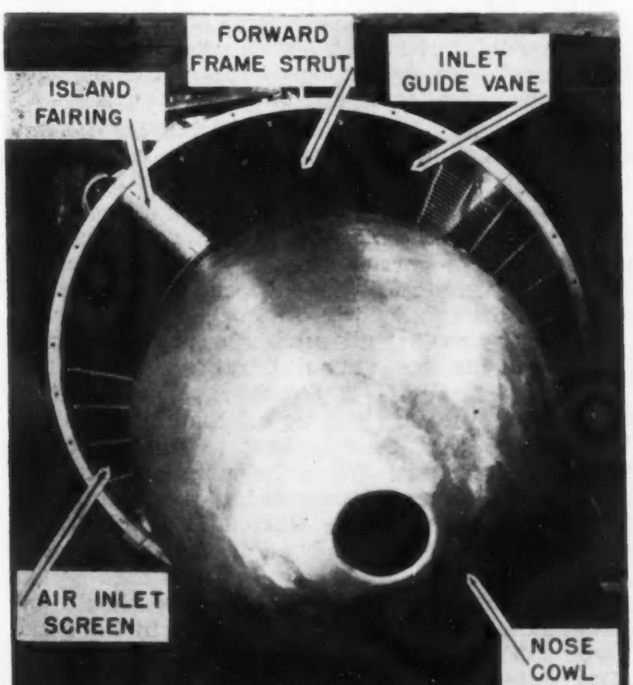


Fig. 1—Anti-icing protection was provided for the air intake components of the J-47 turbojet engine shown

Most acceptable method at present is to make the screen retractable. As shown in Fig. 2, it can be removed out of the air stream during icing conditions.

The retractable screen consists of eight sections, each hinged on the air guide and electrically actuated by a system of flexible drives and screw jacks. For engine checkout and taxiing, the screen is closed and only retracted when airborne. If icing conditions prevail on the ground, the screen must be retracted before starting the engine.

Big problem with this system is safe removal of foreign particles on the screen before retracting it. Foreign particles collected may be held in position during retraction by the aerodynamic wind load. If such is the case, relief doors in the air inlet may be satisfactory. But accommodating increased inlet diameter for the screen in retracted position and the dump doors may be difficult on some installations.

Compressor inlet guide vanes (first row of stationary blades) collected a lot of ice in tests on an unprotected engine. Fig. 3 shows this situation after a moderate icing run.

Anti-icing the inlet guide vanes proved to be a simpler problem than originally anticipated. Beginning with design of the J-35 engine, hot air has been carried forward to the compressor front end, as shown in Fig. 4, to counterbalance a thrust load on the antifriction bearings.

This counterbalance air flow was used as a heat source for anti-icing the hollow inlet guide vanes. Passing the hot air for the counterbalance piston through hollow guide vanes first gave anti-icing protection at no additional cost in performance.

The manifold for the hot air is designed as an integral part of the hollow inlet guide vane assembly. Solid inserts for inlet guide vanes were found most efficient from a heat transfer standpoint.

Ice forming on the guide vanes under severe icing

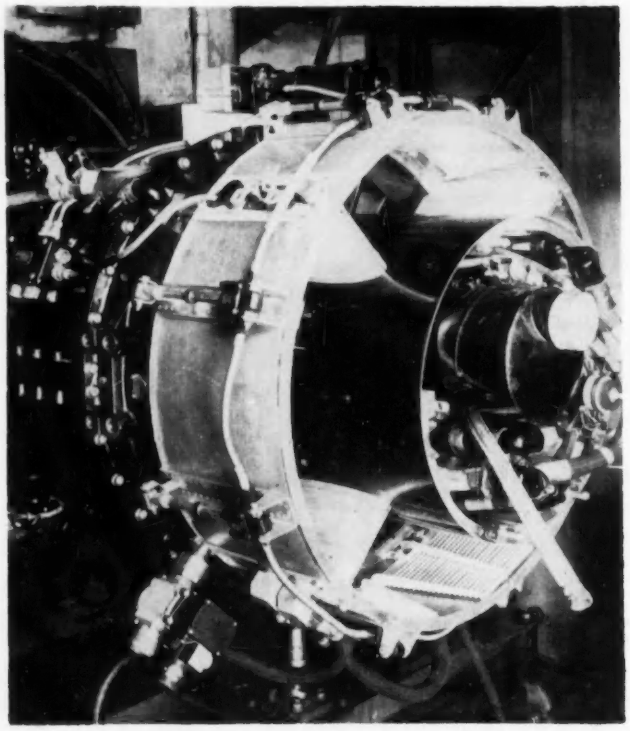


Fig. 2—The air inlet screen can be retracted out of the air stream during icing conditions

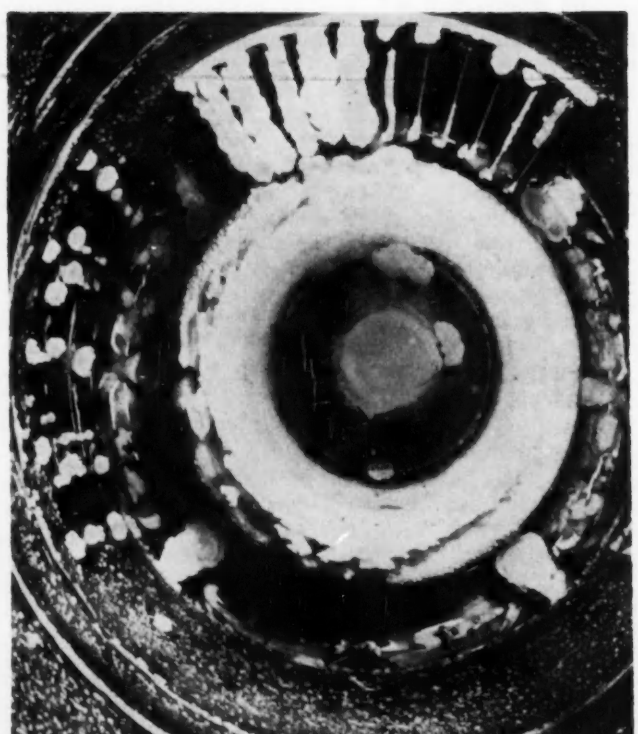


Fig. 3—Note how the unprotected compressor inlet guide vanes iced up during a moderate icing run. Half of the blades were protected and were not bridged with ice

conditions at idle would start at the trailing edge and work forward on the concave surface of the vane. Then it would form on the leading edge. During most icing tests, the guide vanes would be free of ice, except for traces on the trailing edge at low speeds.

This portion of the vane is the hardest to protect because of the large surface available for convection of heat away and the small cross-sectional area for conduction of heat to this region. But slight ice formation on the trailing edge of the inlet guide vanes is no problem since it does not form when aerodynamic considerations are important.

The first stages of rotor and stator blades need not be protected, as originally believed. Ice collects on the first stage rotor and compressor blades and, in some cases, as far back as the third stage. This happens at power conditions close to idle. Ice undoubtedly somewhat affects performance, but never to the extent of choking off the airflow.

Short duration acceleration to high power immediately clears the rotor blades of this ice. These blades run entirely free or with negligible ice coating from about 50% speed and above. Protecting these blades, if found necessary after more extensive flight testing, will be a more difficult job.

Island fairings housing the service lines to the accessory section, and struts, supporting the compressor forward frame, have an air foil shape. They collect ice like aircraft wings. Ice formations on these parts do not affect performance. But they cannot be tolerated because of the potential hazard from ice chunks breaking loose from them and passing through the compressor.

These parts are anti-iced by hot air, much like the heated wing, with about 20% of the chord heated. The relatively small amount of hot air is supplied from the manifold loading to the guide vane assembly. "Run back" from struts and vanes has occurred, but not at high engine speeds (60% and above). Below this speed range, the accumulation has not affected engine performance.

The amount of hot air needed to anti-ice the forward frame struts and island fairings is very low. Thus the performance loss is negligible.

The hot-air method has proved the most economical for the accessory section nose cowl. Cowl protection must be carried back beyond the point of maximum diameter to prevent large ice formations from "run back." See Fig. 5. The nose of the cowl in which the cooling air tube is located was found to be one of the most difficult parts to keep ice-free.

On many tests of early designs, ice completely blocked the entrance, cutting off cooling air to the starter generator. Getting heat to the tip of the lip is very important. When the entrance lip of this duct was satisfactorily protected, it was found that dangerous amounts of ice started to form farther downstream at the offset bend to the starter-generator.

For maximum protection, this tube should be heated along its full length, or at least in the bend as well as the entrance lip.

Our tests also showed that the inlet duct, hose cowl, and all other components should be very smooth, with gentle bends and no sharp protrudances, for icing as well as aerodynamic reasons.

Under certain icing conditions, the flush screws holding surface thermocouples and the bolt heads on the side of the duct collected dangerously large chunks of ice.

The complete anti-icing system was tested over a wide range of operating conditions at the Mt. Washington[1] facilities. These ground test results proved the system to be satisfactory, as shown in the panel on pp. 46 and 47.

Final proof, as for all aircraft equipment, is flight testing under natural conditions. A B-29 flying test bed, on which the J-47 equipped with anti-icing system was installed, made extensive flights through the Mid West and Pacific Coast regions. It ran into icing conditions on five of these flights.

Table 1 lists the severest meteorological conditions met during flight. After 18 min. in this icing condition, no ice formed on the protected inlet components and engine performance was unaffected. The inlet guide vanes, island fairings, and struts were free of ice.

Ice did build up on the No. 2 island fairing due to the malfunctioning of an experimental electrical heating element. Ice also formed on the two instrumentation tubes. The generator cooling air duct was closed off to about one-half its original diameter. This was due to incomplete coverage with electrical heating pads.

After 56 min in the icing weather, the ice formation was the same as at 18 min and engine performance was still unaffected.

These tests were conducted during the late winter and early spring of 1949 with the original experimental anti-icing equipment. Continued development has improved the performance and durability of this equipment.

Ice Entering Compressor

From these tests we also built up considerable experience with pieces of ice entering the engine inlet under flight conditions. This is a far from desirable condition and the cause of much concern.

During flight tests, much ice went into the compressor. No damage was visible after the last flight and the engine operated satisfactorily for the remaining 30 hr before it was replaced at the end of the program.

Some of the ice originated from a strut ahead of the engine. This strut had a ½-in. chord and the ice on it extended 3 in. forward of the leading edge and mushroomed to about 1¼ in. wide. The strut was vibrating so that the ice broke off periodically.

The ice was seen to go into the compressor about 20 times in one flight. The larger pieces were estimated to be 3 in. long, 2 in. wide, and ½ in. thick on one end to about ¼ in. on the opposite side.

On another flight, when the accessory section nose cowl heaters were turned back on, the ice—which had accumulated—broke loose and went into

[1] For a description of the Mt. Washington test facilities, see SAE Journal, January, 1951, pp. 25-28: "Turbine Anti-Icing Tested Atop Mt. Washington," by P. M. Bartlett and T. A. Dickey.

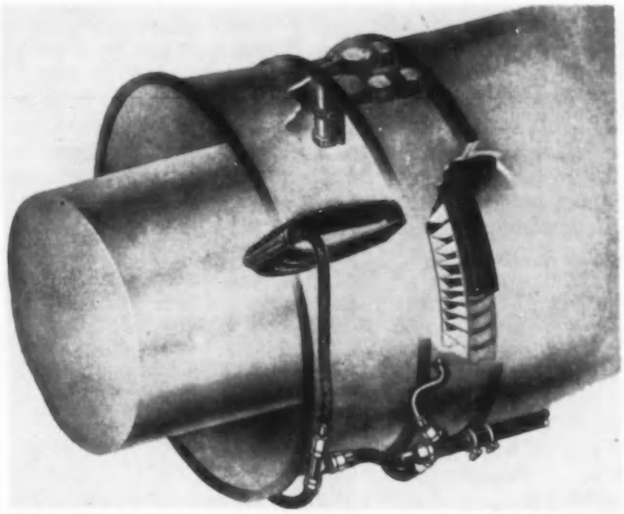


Fig. 4—Hot air introduced at the air inlet gives anti-icing protection to the inlet guide vanes, island fairings, and struts

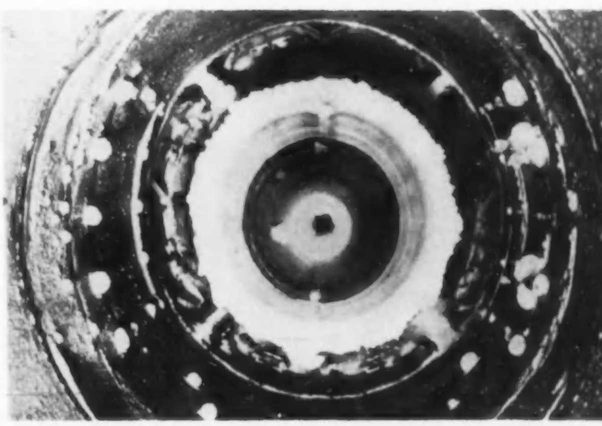


Fig. 5—Ice accretion forms on the unprotected portion of bullet-nose cowl

Table 1—Atmospheric Conditions During Flight

Ambient Temperature	Liquid Water Content (g per m³)	Droplet Size (microns)	Altitude	Indicated Air Speed (mph)	Elapsed Time in Ice Min.	Engine Speed (rpm)
7 F	0.48	10.8	8500	185	18	7200
7 F	0.54	9.2	8600	195	29	6000
7 F	0.48	29.0	9200	195	49	6000
3 F	—	—	8900	200	56	—

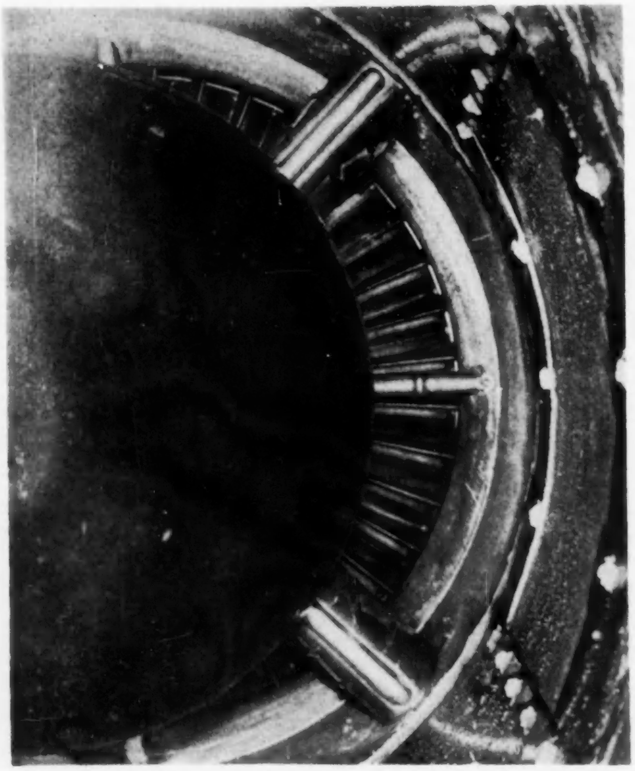
the compressor. This ice broke loose in sheets about $\frac{3}{8}$ to $\frac{1}{2}$ in. thick and the side dimensions of the larger pieces were estimated to be 6×5 in.

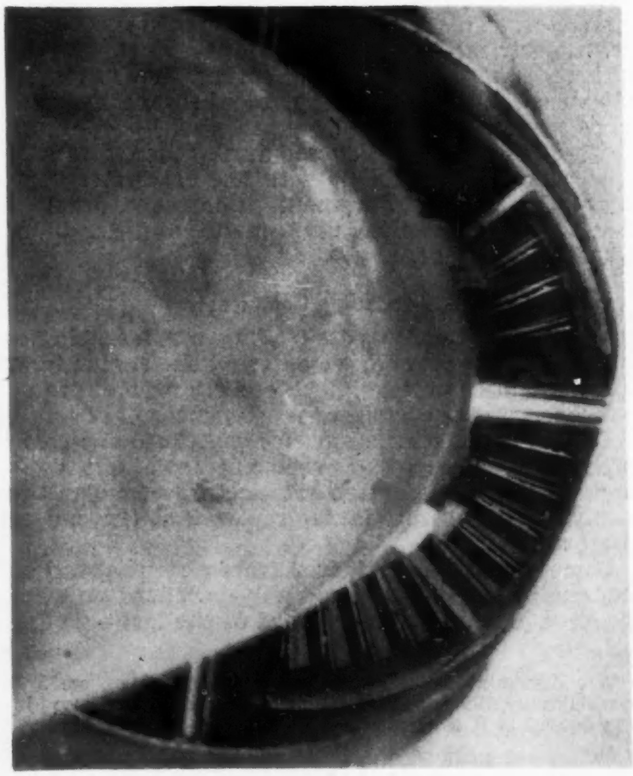
Ice built up about $1\frac{1}{4}$ in. wide and 3 in. long on the instrumention tubes in the compressor inlet. This ice periodically broke off and went through the engine. A ball of ice about $1\frac{1}{4}$ in. in diameter would build up around the bent portion of the impact tubes and these pieces of ice also went through the engine.

Type and size of ice that can successfully pass through an engine is a controversial subject. Large ice chunks—many larger than those mentioned—passed through the engine on Mt. Washington without harm. The largest of the pieces entering the engine is estimated to have been $4\frac{1}{2} \times 6 \times 2$ in. Even much larger pieces hitting the inlet guide vanes and shattering made no dents and did no damage.

But on one occasion during each winter season compressor blades were damaged. It was felt that foreign ice pieces, from some place ahead of the engine, caused this damage. As a precaution, the parts were changed before continuing the tests.

Ground Test Results





Low Engine Speed:

The low engine speed range is the most critical for thermal anti-icing systems of the type used on this engine. The engine's anti-icing ability depends on heat transfer from the compressor discharge bleed air, which at low engine speeds is low in pressure and temperature. The J-47's performance in this critical region is good. As shown above, only slight traces of ice accumulated during 12 min operation at idle speed (37% or 3000 rpm) under medium liquid water contents.

Low Ambient Temperature:

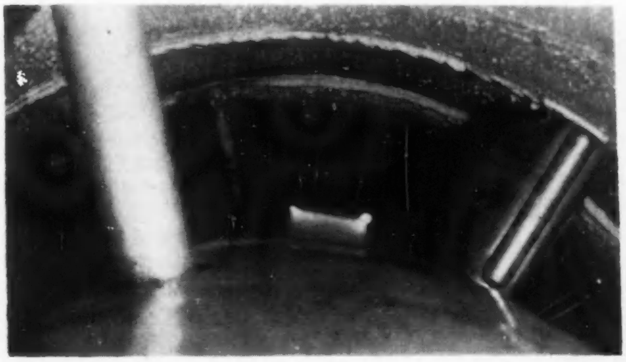
As a further check of idle speed operation, low ambient temperature conditions were investigated. A test run was made at −18 F ambient temperature. The result, as shown, was negligible icing of the inlet to the engine. Island fairings were completely ice free. A thin coating covered the inlet guide vanes and several struts. Some ice built up on the leading edges of the first stage stator blade, but none of the passages between blades was obstructed to any degree.

But if this had happened in flight, it would not have caused loss of the aircraft.

Experience gained in regard to ice entering the aircraft showed that for greatest safety, all aircraft components ahead of the compressor inlet require anti-icing protection. At no time should the ice be allowed to form to any dangerous degree before turning on the anti-icing system.

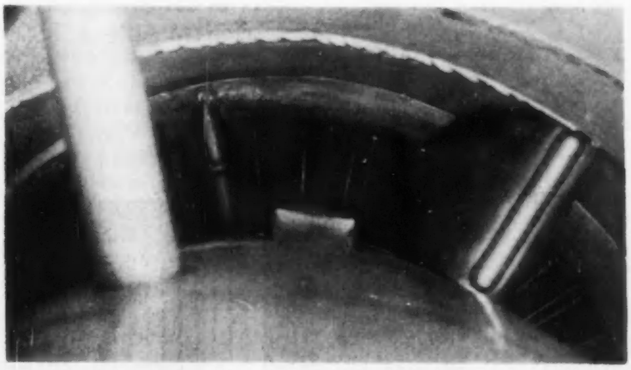
(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members; 50¢ to nonmembers.)

at Mt. Washington



Cruise Power:

No ice formed on protected portions of the engine at high power conditions. The photo above, taken at cruising rpm under heavier-than-average liquid water content, showed very little ice build-up.



Normal Power:

The high power setting, on the same run as above, shows an equally clean inlet. This photograph is about the same as the one above, except all ice traces are gone, even from leading edge of first stage stator blades.

Air Cargo Day

Continued from Page 37

fuselages to maximum speed, one civilian reminded them that even with a large load accomplishing a mission requires getting there and back without getting caught.

The commercial attitude was that the larger the airplane, the more time required to load it, and the slower the service rendered to the shipper. The bulk of commercial air cargo will always be small express shipments which must be moved on high-frequency flights, meaning probably passenger flights. Where volume justifies all-cargo flights, the key to low direct operating cost is high ton-mileage per gallon or per pilot hour, which the experts interpreted as high airplane speed. One of them suggested that, since all-cargo flights need not consider passenger safety and since safety and speed may be assumed to vary inversely, the fastest aircraft should be used for cargo.

Eager as commercial operators were to find ways to reduce direct operating cost of flying cargos, they were more eager to cut terminal costs. Their expressed goal is to get terminal costs down to half flight costs and to cut the overall cost to 10¢ per ton-mile.

Many felt that the best approach is mechanization, at least for large-volume operations. One type of mechanization that interested them was an airplane-parking device, exhibited in small-scale model form in the Air Cargo Display. This device includes two ground-level conveyor strips which extend out from the terminal a distance of 50 ft or more. The pilot of an incoming plane positions the main landing wheels on one strip and the nose or tail wheel on the other. Then the airplane is drawn to the terminal on the conveyor strips. Object is to save maneuvering time and get the aircraft closer to the terminal. The Whiting Corporation was reported to be installing such a system at Avianca's new Barranquilla cargo terminal in Colombia, South America.

The other type of mechanized cargo-handling equipment for terminals considered at the meeting was tows for dollies. Moving chains sunk below floor level were favored over overhead types because they offer no overhead obstruction and they accept dollies shoved to them from any direction. Proponents of the mechanized tows knew of no such installations in air terminals, but they reported benefits realized in trucking and warehousing industries: The work is lightened, and the entire handling operation is speeded up by the pacing effect of the continuous tows.

Labor's opposition to this and other types of materials-handling equipment was reported to have died down, making it one more aid to a financially healthy air cargo industry, able to function as the backbone of the national airlift.

SAE Aero Standardization Geared to

The Men Who Head The SAE Aeronautics Program

R. D. Kelly is superintendent of technical development, United Air Lines, Inc.

A. E. Smith is chief engineer of Pratt & Whitney Aircraft, Division of United Aircraft Corp.

Erle Martin is general manager of Hamilton Standard Division, United Aircraft Corp.

R. D. Kelly
Chairman, SAE Aeronautics Committee, and member of SAE Technical Board

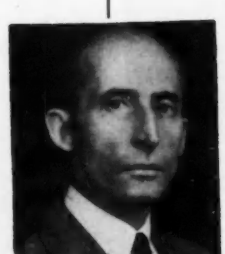
J. B. Johnson is chief of the Metallurgy Group, Office of Air Research, Air Materiel Command

Arthur Nutt is a consulting engineer

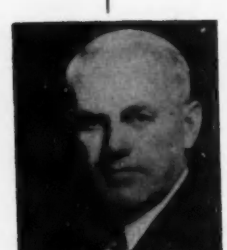
W. C. Lawrence is director of design engineering, American Airlines, Inc.

A. E. Smith
Chairman,
Aircraft Engine Division

Erle Martin
Chairman,
Aircraft Propeller Division



J. B. Johnson
Chairman, Aeronautical Material Specifications Division



Arthur Nutt
Chairman, Special Aircraft Projects Division

W. C. Lawrence
Chairman, Aircraft Accessories and Equipment Division

Military Preparedness

SAE's aeronautical standardization program, attuned to military needs since before Pearl Harbor, is making a significant contribution to today's rearmament program. Every military combat and transport plane flying today, and even those still on the board, incorporates materials or parts specified in SAE Aeronautical Standards and Aeronautical Material Specifications.

Table 1, showing the number of specifications currently in use and the number distributed during the past year to the aeronautics industry, gives some indication of the active role these standards play in today's aircraft production.

The 28 committees under the SAE Aeronautics Committee are fulfilling requests from the military directly as well as indirectly by work with industry on standards for military materiel. This committee framework is geared for any accelerated demands the Air Force or Navy Bureau of Aeronautics may make in an emergency. The committees operate under the five divisions shown at left—Aircraft Engine, Aircraft Propeller, Aeronautical Material Specifications, Special Aircraft Projects, and Aircraft Accessories and Equipment.

Considerable impact on military aircraft engineering has been made by the SAE Engine and Propeller Utility Parts Committee, E-25. It has recommended more than 300 standards that have been designated AN Standards by the military. An industry-military agreement several years ago resulted in the transfer of this standards-making job for certain aircraft engine and propeller utility parts from the Air Force and Navy to this SAE group.

Aim of this move was to achieve highly uniform quality in parts such as bolts, nuts, gaskets, and washers as needed by engine, propeller, and accessory manufacturers.

Under the present working arrangement, the Committee develops recommendations for standards, coordinates them with interested manufacturers and the military, and, with the approval of the SAE Aeronautics Committee and Technical Board, submits the final proposal to the Aircraft Industries Association for transmittal to the military services.

Chairman of Committee E-25, J. D. Clark, Navy Bureau of Aeronautics, reports that all future SAE utility parts standards adopted by the military will be designated Military Standards, carrying the designation "MS" instead of "AN." However, existing AN standards will not be changed to the new MS series until they are superseded.

Recommended practices for quick attach-detach mountings now being developed by an SAE group should make savings in another important item in military aircraft operations—maintenance time. The conventional method of bolting accessories such as generators to the engine makes it tough to replace units in service. In cold weather operations in particular, removing and replacing a bolted unit can be a difficult and time-consuming job for mechanics on the line. It's been known to take as long as 8 hr.

A proposed SAE recommended practice, now being completed, shows several quick attach-detach devices. It specifies as a design objective that the

Table 1—Current SAE Aeronautical Standards and Specifications and Quantity Distributed in 1950

	Number of Current Documents	Quantity Distributed in 1950
Aeronautical Materials Specifications	542	300,037
Aeronautical Standards and Recommended Practices	179	18,552
Aeronautical Information Reports	21	656
Aeronautical Drafting Manual	—	534

accessory be attached to, or detached from, the engine within 1 min with these devices. This recommended practice will apply to reciprocating aircraft engines, turbojets, and turboprops.

SAE standards and specifications are under way for a complete line of fractional horsepower electric motors. They should simplify supply problems for both the military services and industry. End product of this current project will be standardized ratings, flange dimensions, speeds, and torque of these motors.

Interchangeability of different manufacturers' motors on the same equipment, should simplify stocking and eventually cut down inventory requirements. For example, it was reported that the Navy found it was storing about 500 separate types of such aircraft electrical motors. Such a standardization program should make a considerable reduction in number of types needed.

SAE Aeronautical Materials Specifications, too, play a big role in design and manufacture of aircraft and their components. Much of the ferrous, nonferrous and nonmetallic materials used by the industry are purchased to AMS. These specifications also include finishes and processes.

While the AMS program is mainly an industry job, a close working liaison is kept with the military services.

Typical of the way in which the AMS Division keys its activities to military needs is its work in helping to ease a serious tightening of columbium supplies. Demand for columbium, a stabilizing agent necessary in jet and gas turbine steel alloys which the United States is now stock-piling, threatened to outstrip supply. Tantalum can replace columbium altogether or in part, depending on the particular steel. Alert to the situation, the SAE Aeronautical Material Specifications Division revised some 18 AMS to permit use of both columbium and tantalum, interchangeably or in combination. This move is helping materials vendors extend the columbium supply.

Exacting demands of today's jet and gas turbine engines powering military craft are successfully met by heat and corrosion-resistant materials complying with AMS. The Division, headed by J. B. Johnson, Air Materiel Command, continuously is developing new specifications and revising existing ones to fulfill changing needs of the industry.

The SAE Aeronautical Drafting Manual, product of a group under the Special Aircraft Projects Division, is designed especially for engine, accessory, and propeller manufacturers and airline operators. The Manual is an outgrowth of World War II experience to correct the lack of a common graphic language.

In general use throughout the industry for over three years, the Manual aims for uniformity of expression in, and interpretation of, drawings to eliminate ambuiguities. Such blueprint misunderstandings during the last war between Engineering and Manufacturing of even the same company proved costly in delays and rejects. Adoption of these standard drafting practices by manufacturers of military aircraft materiel should facilitate production expansion.

The SAE Aeronautical Drafting Manual Committee, headed by O. E. Kirchner, American Airlines, Inc., keeps the Manual up-to-date with new developments. For example, a current project of immediate importance to jet engine manufacturers is a uniform method of dimensioning gas turbine blading. The wide variety of systems now used by turbojet and turboprop engine builders places a hardship on the blade supplier. He must invest in gages and tooling for inspecting blades dimensioned by different systems. A standard dimensioning method is sought by the Committee.

The growth of helicopter land and ship use in military operations brings into sharp focus the basic data on helicopter engineering produced by the SAE Helicopter Committee. This group, also under the Special Aircraft Projects Division, has authored seven reports on design fundamentals. Included are: A Method of Ground Resonance Testing for Helicopters, Preliminary Testing of Helicopter Transmissions and Design Life of Helicopter Transmissions, A Criteria for Fatigue Testing of Helicopter Transmissions, and Desirable Characteristics for Helicopter Engines.

Committee Chairman J. P. Perry, Eastern Rotorcraft Corp., says his group is active on other reports of an equally basic nature.

Forums for exchange of ideas between military and industry aeronautical engineers are the meetings of three SAE hydraulic and pneumatic equipment committees. They are: Aircraft Pumps, A-1; Aircraft Valves, Fittings, and Flexible Hose Assemblies, A-3; and Aircraft Hydraulic and Pneumatic Equipment, A-6.

At these sessions engineers of the Air Force and Bureau of Aeronautics learn first-hand from industry men how military hydraulic and pneumatic standards are working out manufacturing-wise. Suggestions direct from design board and factory floor help the military standards groups make their specifications more practical and realistic. Men from the services also request and get the help they need in their work.

Round-table talks at these meetings, often attended by more than 100 men, have marshalled interest and help on the nonflammable hydraulic fluid development. Committee A-6 is forging ahead on specification requirements for design, testing, and installation of aircraft pneumatic equipment. Dimensional specifications for cylindrical accumulators, which weigh less and take less space than spherical types, also are nearing completion under A-6 auspices.

In addition to developing their own standards and specifications, groups under the SAE Aeronautics Committee cooperate with organizations such as the American Society for Testing Materials, Air Transport Association, American Institute of Electrical Engineers, Aircraft Industries Association, and National Electrical Manufacturers Association.

Suggestions from all interested groups—manufacturers, users, trade associations, and professional societies—are solicited on all standards and specifications before they are completed. Engineers from industry as well as from the military services serve on SAE committees. Technical progress in the industry is under constant surveillance by these groups with an eye toward keeping the standards up-to-date.

Dale Roeder

SAE PRESIDENT FOR 1951

DALE ROEDER is president of the Society of Automotive Engineers for 1951. He was elected by the SAE Council on Jan. 9 to fill the vacancy left by the death of president-elect James E. Hale. (The SAE Constitution provides that the Council shall elect one of its own number in such instances.)

Roeder is executive engineer, commercial vehicles, Ford Motor Co. He has had a finger in engineering almost every kind of automotive product since joining Ford back in 1925.

As chief engineer of commercial vehicles, prior to his promotion to executive engineer in 1949, he has played an important part in this area of development for many years. Now, tractors and operation of the 2200 acres of Ford experimental farms are also part of his responsibilities. Earlier, he did much of the gear work on the original Model A design—and even participated in the Ford all-metal plane program by way of some stress analysis work.

He was in a student army training corps in World War I. And in World War II, he was engineer in charge of all military wheeled and track-laying vehicles produced for U. S. Army Ordnance by Ford. Included in this latter chore were medium tanks, armored cars, jeeps, and trucks.

As a very young man, he touched base briefly in the steam shovel and railroad locomotive fields, but set his first serious sights on automotive research as a profession. That is what he had in mind while completing his Ohio Northern University course which led to a B.S. in mechanical engineering—and while teaching and taking postgraduate work at Iowa State College on his way to an M.S. in automotive engineering.

But a chance to join Ford as a chassis draftsman came along to change that original aim. Interest in special assignments ranging from stress analysis to patent work brought him early recognition and steady advancement in Ford Engineering.

Sound, clear analysis of administrative as well as technical problems is an everyday Roeder characteristic, associates say. He is mild-mannered, good-humored, and determined in action.

Roeder joined SAE in 1928; has contributed greatly to its progress. He was vice-president for Truck & Bus Activity in 1948, and was starting the second year as a Councilor for the 1950-51 term when he was elected to the presidency.

He was born in Lima, Ohio, in 1900.

SAE COUNCIL

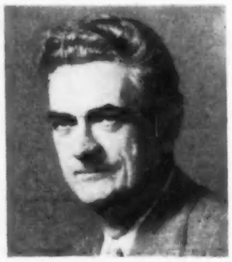
Completing the 1950–51 term as councilors are W. E. Conway, Studebaker Corp., and P. J. Kent, Chrysler Corp. L. Ray Buckendale, Timken-Detroit Axle Co., has been elected to fill the unexpired 1950–51 term as councilor made vacant by Dale Roeder's election as president. B. B. Bachman, Autocar Co., serves again as treasurer. S. W. Sparrow, Studebaker Corp., and James C. Zeder, Chrysler Corp., continue on the Council as past-presidents. All vice-presidents representing activities are members of the Council. Shown below are the three new councilors, for 1951–52.

W. E. Conway

B. B. Bachman

P. J. Kent

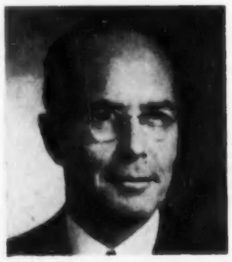
S. W. Sparrow



L. Ray Buckendale

James C. Zeder

E. F. Armstrong



E. F. Armstrong (M '33) was born in Iroquois, Ontario, and graduated in 1922 from the University of Toronto. He has been with General Motors of Canada since immediately after graduation, when he joined the engineering department.

From 1928 until 1931 he was resident engineer at the company's Walkerville plant where trucks, buses, engines and front axles were built. He returned then to Oshawa and held various positions in the GM engineering department until his appointment as chief engineer in 1946.

Armstrong has served SAE Canadian Section as vice-chairman (1946–47) and chairman (1947–48).

Robert F. Lybeck

Robert F. Lybeck (M '25) is manager of aviation sales for the New England Division of Esso Standard Oil Co. Last year he received the company's 30-year service award, having joined the company in 1920 as a chemical engineer. He advanced through various technical and sales positions until 1939, when he was assigned to his present post. He had worked previously for Merrimac Chemical Co. and U. S. Color & Chemical Co.

Lybeck was born in Worcester and got his BS in chemistry and his MS from Tufts College. Last year he received Tufts College's Distinguished Service Award for outstanding and meritorious service to his Alma Mater.

He was chairman of SAE New England Section in 1931–32.

Wellwood E. Beall

Wellwood E. Beall (M '29) has been vice-president of engineering and sales for Boeing Airplane Co. since 1946. He is in charge of design of Boeing planes and guided missiles and attendant engineering research. Beall got his professional degree in aeronautical engineering at University of Colorado, and his BSME and BSAE at the Guggenheim School of Aeronautics.

After graduation he was assistant chief aeronautical engineer for the Walter M. Murphy Co. He joined Boeing in 1930 as an instructor in the School of Aeronautics, and was successively sales engineer, far eastern manager in Shanghai, chief commercial projects engineer, and chief engineer. He is a fellow of the IAS, and contributes articles to various scientific and engineering magazines.

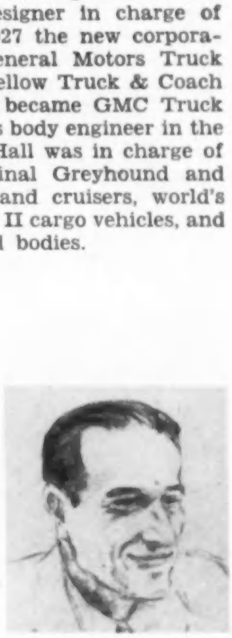
VICE-PRESIDENTS

Frederick A. Hall
Vice-President, Body

Frederick A. Hall (M '24) has spent 27 years in the truck and bus industry with General Motors Corp. and its subsidiaries. Before joining GMC, he spent four years with International Harvester Co. as draftsman on farm implements and World War I military escort wagons, and three years with Walker Vehicle Co. as draftsman on electric trucks.

In 1923 he started to work as draftsman with Yellow Coach Co., working on double-deck open-top buses. When Yellow Coach merged with Yellow Cab Mfg. Co., he was promoted to body designer in charge of both divisions. In 1927 the new corporation merged with General Motors Truck under the name of Yellow Truck & Coach Co, which eventually became GMC Truck & Coach Division. As body engineer in the merged corporation, Hall was in charge of body design on original Greyhound and metropolitan buses, land cruisers, world's fair buses, World War II cargo vehicles, and sheet metal cabs and bodies.

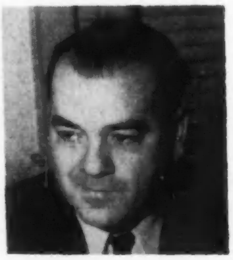
Carl W. Georgi
Vice-President, Fuels & Lubricants



Carl W. Georgi (M '33) is technical director of Quaker State Oil Refining Co.'s research laboratories and vice-president of Enterprise Oil Co., Inc.

Georgi has been widely active in the petroleum field. He has published a large number of papers and articles on lubrication, and is the author of a newly-published book on "Motor Oils and Engine Lubrication." He is a member of the American Chemical Society and American Society of Lubrication Engineers, and serves on committees of the National Lubricating Grease Institute, the ASTM, API, and CRC. He is a member of the SAE Fuels & Lubricants Technical Committee.

Rolland L. Anderson
Vice-President, Air Transport



Rolland L. Anderson (M '43) is director of engineering and research for Chicago & Southern Air Lines. He has been with the airline since 1934, when he was engaged in maintenance work. The same year he was named superintendent of maintenance; in 1942 he became superintendent of engineering; and in 1948 he began his present position.

Anderson majored in machine design, pattern-making and drafting at Riverside Polytechnic Junior College. He began his aviation career in 1930 with Coast Airways where he was in charge of maintenance.

R. M. Hazen
Vice-President, Aircraft Powerplant

R. M. Hazen (M '24) has been director of engineering at Allison Division, GMC, since 1936. There he has been in charge of development and design of Allison engines used in World War II fighter aircraft and advanced design of turbojet and turboprop engines for military postwar aircraft.

Hazen's aircraft engine experience began shortly after his graduation from University of Michigan and post-graduate work at University of Minnesota with two years as a mechanic and pilot in World War I. Since then he has worked for General Motors Research Laboratory, Wright Aeronautical Corp., and Fairchild Airplane & Engine Corp., and has been an assistant professor of mechanical engineering at University of Minnesota. He is a member of IAS and NACA, and is active in committee work for both.

VICE-PRESIDENTS

H. H. Hooker
Vice-President, Truck & Bus

Harry H. Hooker (M '38) was born, educated and held his first three jobs in Monongahela, Pa. He did structural, machine, and automotive design work for the Capell Fan & Engineering Co., the Herron-Webb Engine Co. and Liggett Spring & Axle Co.

In 1918 he went to Cleveland, where he was employed as a checker in the engineering department of Standard Parts Co. He soon joined Forbensen Axle Co., which later became part of Eaton Mfg. Co., where he is now assistant chief engineer.

Hooker is a past secretary and treasurer of Cleveland Section and has served on various SAE technical committees. He was chairman of the Truck & Bus Activity's membership committee in 1949.

F. P. Zimmerli
Vice-President, Engineering Materials

F. P. Zimmerli (M '27) has been chief engineer of Barnes-Gibson-Raymond Division of Associated Spring Corp. for the past 25 years. He received his BS, MS and Metallurgical Engineering degrees from University of Michigan, and was employed by Solvay Process Co., Dodge Bros., and Rickenbacker Motor Co. after graduation.

Zimmerli is a member of ACS, ASTM, ASME, ASM, AIME, and the Engineering Society of Detroit, in many of which he has held elective office. He is the author of numerous articles on spring design, shot-peening and materials used for resilient members, published by various engineering society publications.

R. W. Seniff
Vice-President, Diesel Engine

R. W. Seniff (M '45) graduated from Illinois Wesleyan University in 1924. He has spent the succeeding 26 years in railroad work concerned with design, construction, operation, and tests, with special emphasis on prime movers. He has worked as chemical engineer and engineer of tests for several railroads, and is now with the Baltimore & Ohio in the latter capacity.

Seniff is active on the diesel fuel committees of the CRC and ASTM, and the specification and wheel committees of the Association of American Railroads. He is also a member of the ASME, the ACS, the American Railway Engineering Association, and the American Military Engineers. He has written several papers on power boilers and diesel engines.

R. J. Woods
Vice-President, Aircraft

R. J. Woods (M '41) joined Bell Aircraft Corp. in 1935. During that same year he became chief design engineer, the position he holds today.

Woods worked for Truscon Steel Co. as a design engineer before going to University of Michigan, where he received his BS in mechanical and aeronautical engineering in 1928. Before joining Bell, he was employed by the NACA at Langley Field, the Towle Aircraft Co., Detroit Aircraft Corp., Lockheed Aircraft Corp., and Consolidated Aircraft Co.

He was an ROTC cadet captain during college, and served 18 months as boatswain 1st class with the Coast Guard and 4 months of temporary duty with the USAAF-ATI with the assimilated rank of colonel.

He is a member of the IAS and the Engineering Society of Buffalo, and a past-president of the Aero Club of Buffalo.

VICE-PRESIDENTS

R. C. Williams
Vice-President, Tractor & Farm Machinery

R. C. Williams (M '45) has been with Caterpillar Tractor Co. since his graduation from University of Illinois in 1932. He began as an engineering trainee, and worked as laboratory engineer and later as field engineer for the engineering department until Caterpillar's research department was organized. He continued as field engineer in the new department until 1945, when he was appointed staff engineer to work on development of tractors and earthmoving equipment. In his present position as assistant director of research he is in charge of research work on tractors and earthmoving equipment.

Williams has been actively engaged in SAE activity and technical committee work, and has held many offices, including the chairmanship, in SAE's Central Illinois Section.

George A. Delaney
Vice-President, Passenger Car

George A. Delaney (M '23) has been with Pontiac Motor Division of GMC since 1934, when he was an electrical engineer. He became assistant chief engineer in 1939, and became chief engineer in 1946.

Delaney got his BS in engineering at the University of Missouri, then served two years as a first lieutenant in the Army. His first job was draftsman for Savage Arms Corp. From 1920 until he came to Pontiac, he was with the Paige-Detroit Motor Car Co., and, when its name was changed, Graham-Paige Motors.

He has been active in both SAE National and Section work. At present he is a member of the Technical Board and the Meetings Committee, and is treasurer of SAE Detroit Section.

Rodger J. Emmert
Vice-President, Production

Rodger J. Emmert (M '27) has been associated with General Motors Corp. since 1919, when he joined the Remy Electric Division as electrical engineer. Since then his positions have included president and general manager of the Delco Products Corp., now a GMC Division, and president of General Motors Radio Corp. In 1948 he was assigned his present position as executive in charge of the production engineering and processing sections of GM's manufacturing staff. The two sections are concerned with coordination of technical activities in the various divisions, and developing better manufacturing methods.

His career began in 1916, after his graduation from Case School of Applied Science, as a member of the engineering staff of Westinghouse Electric & Mfg. Co. He served two years as a computer in Ordnance design at the U. S. Navy Yard in Washington during World War I.

Joseph A. Harvey
Vice-President, Transportation & Maintenance

Joseph A. Harvey (M '29) became interested in automobiles at an early age. After his graduation from the Buffalo Automobile School, he worked as auto mechanic, diesinker, and toolmaker for various automobile companies.

He served as a machinist's mate in World War I, and afterwards graduated from Carnegie Institute of Technology as a production engineer. He worked for several companies in managerial capacities, reorganizing their personnel and production facilities until 1928, when he became automotive engineer for Pittsburgh Railways Co. In 1938 he started his present position as superintendent of equipment and garages for Pittsburgh Motor Coach Co.

Harvey served in World War II as expert consultant to the Army Quartermaster and Ordnance. He has been active on various SAE technical and Activity committees, serving as chairman of several.

MILITARY OVERTONES 1951 ANNUAL

Continued from Page 17

root causes of accidents are the root causes of all the great problems of the age."

And Horning Medal winner D. P. Barnard, research coordinator, Standard Oil Co. (Ind.), said that one-third of the product and process improvement effort of the great oil companies is directed toward ways of improving gasoline quality. "Although the engines built during the last decade seem to have left little to be desired," he said, "the automotive industry is currently prosecuting its development and design work with at least as great and possibly even greater effort than ever before. Similarly, the petroleum industry is not resting on its laurels of catalytic cracking or any other process."

(The Beecroft Lecture will be printed in full in the March, 1951 SAE Journal. The Horning Lecture in the April, 1951 SAE Quarterly Transactions.)

MOBILIZATION NEEDS were reflected in discussion and action in technical committees throughout the week. . . . The Technical Board's Army Advisory Committee, headed by SAE Past-President James C. Zeder, met Jan. 11, heard progress reports—and stressed fast action for completion of military projects now under way.

ALSO, the Iron & Steel Technical Committee's subcommittee on Review of Ordnance Steel Specification met and came closer to the finish of its emergency-born job . . . . and the Spring Committee was reported devoting major attention to problems of torsion-bar springing for military vehicles . . . . Boron steels—with hardenability band data on them —were reported on their way by another ISTC subcommittee . . . . and preparedness thinking flavored many other technical committee sessions.

ARMY WINTERIZATION TESTS at Camp Grafton, North Dakota, are being viewed this year by groups of SAE observers. Technical Board accepted an invitation from Ordnance to send relays of SAE observers on recommendation of its Army Advisory Committee.

SAE JOURNAL READERS are promised better information and reports of what goes on at roundtables and clinic sessions during national meetings in 1951. Reason: Most such sessions will be summarized by an expert, chosen by the session leader at the request of the Activity sponsoring the session. Sparked by new National Meetings Committee Chairman E. H. Kelley (Chevrolet's chief engineer), this program grows out of action taken at a meeting of the National Meetings Committee on Jan. 9.

IMPORTANT CONTRIBUTION to the annual dinner of the SAE Past-President's Committee was made by 1941 President A. T. Colwell, as follows:

"How are things going for you?", one Russian asked a fellow mujik.

"Better, Ivan," came the reply. "Better."

"What do you mean 'better'?"

"Why, I just mean better . . . I'm not doing as well as I was yesterday, to be sure . . . but I'm doing much better than I will be tomorrow!"

HIGH-RANKING MILITARY MEN of Army, Navy, and Air Force flanked Under-Secretary of the Army Alexander at the speakers table at the Annual Meeting Dinner. They sat side by side with the top-flight industrialists on whom responsibility rests for the mechanized equipment to back them up. SAE's balanced interest in land and air units was reflected in the representation of industry leaders from both fields.

Here's who sat there: R. C. Firestone, vice-president, Firestone Tire & Rubber Co.; Capt. W. L. Tann, USNR, assistant director, material division for industrial planning, Navy Bureau of Ordnance; H. J. Ferry, president, Packard Motor Car Co.; F. M. Zeder, vice-chairman of the board, Chrysler Corp.; Rear-Admiral A. M. Pride, chief, Bureau of Aeronautics; Glenn L. Martin, chairman of the board, Glenn L. Martin Co.; R. T. Hurley, president, Curtiss-Wright Corp.; H. M. Horner, president, United Aircraft Corp.; Detroit Section Chairman L. I. Woolson, vice-president of manufacturing, DeSoto Division, Chrysler Corp.; 1950 SAE President James C. Zeder, chairman of the engineering board, Chrysler Corp.; Master of Ceremonies Henry Ford II, president, Ford Motor Co.; Dinner Speaker Archibald S. Alexander, Under-Secretary of the Army; 1951 President-Elect Dale Roeder, executive engineer, commercial vehicles Ford Motor Co.; L. L. Colbert, president, Chrysler

DOMINATE MEETING

Corp.; Lt.-Gen. T. B. Larkin, assistant chief of staff, Department of Army; L. C. Goad, executive vice-president, General Motors Corp.; Major-Gen. E. L. Ford, Chief of Ordnance, Department of Army; G. W. Mason, president, Nash-Kelvinator Corp.; Brig.-Gen. D. J. Crawford, commanding officer, Detroit Arsenal; Edgar Kaiser, president, Kaiser-Frazer Corp.; McClure Kelley, president, Austin-Western Co.; J. A. Lawler, president, Aeronca Mfg. Corp.; Brig. Gen. A. H. Johnson, chief, industrial planning division, Air Materiel Command; C. J. Reese, president, Continental Motors Corp.; L. D. Bell, president, Bell Aircraft Corp.; Major-Gen. E. E. MacMorland, commanding general, Aberdeen Proving Ground; A. D. Dennis, president, LaPlant-Choate Mfg. Co., Inc.; R. B. Temple, president, Tire & Rim Association; R. F. King, registrar of motor vehicles, Commonwealth of Massachusetts; A. W. Phelps, chairman of the board, Oliver Corp.; H. J. Klingler, vice-president, General Motors Corp.; SAE Past-President A. W. Herrington, chairman of the board, Marmon-Herrington Co.; Major-Gen. W. H. Maris, deputy assistant chief of staff for research and development, U. S. Army; E. F. Fisher, president, Gar Wood Industries, Inc.; Major-Gen. J. K. Christmas, chief, procurement division, Department of the Army; C. W. Perelle, president, ACF-Brill Motors Co.; L. J. Fageol, president, Twin Coach Co.; R. L. Biggers, president, Fargo Division, Chrysler Corp.

NEW CHAIRMAN of the National Meetings Committee is Edward H. Kelley, chief engineer of Chevrolet

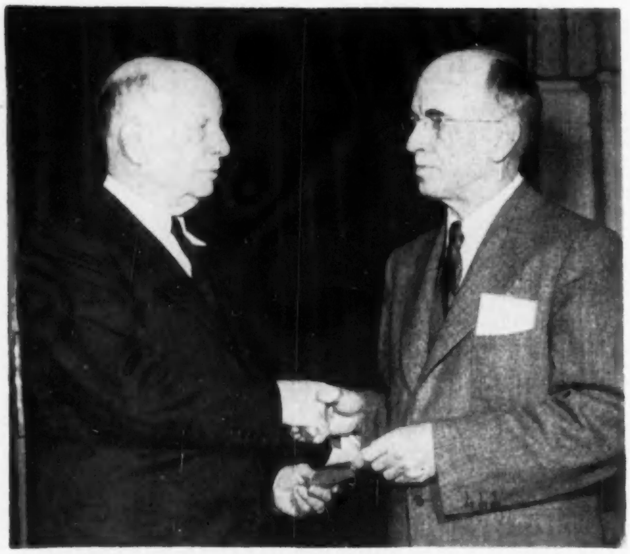
Expanded Military Needs May Stymie Progress in MOTOR FUELS

FULL-SCALE military preparedness will retard gasoline advances, petroleum technologists at the meeting predicted. They also saw gasoline facing growing competition from LP gas (liquefied petroleum gas such as propane and butane), particularly in farm areas. Concern over fuel volatility and carburetor icing tendencies with gasoline emphasized lack of these problems with LP gas.

Impact of a switch in production effort from civilian to military needs became all the more clear from crystal-gazing first through rose-colored glasses at peacetime prospects.

Normal engine-fuel progress, all agreed, will see

Based on discussions and six papers presented at one Tractor and Farm Machinery session and two Fuels and Lubricants sessions . . . "L. P. Gas for Motor Fuel," by **R. C. Alden** and **F. E. Selim**, Phillips Petroleum Co. . . . "Engine and Carburetion Equipment Requirements for L. P. Gas Fuel," by **A. J. St. George**, Ensign Carburetor Co. . . . "Comparative Operating Data of Tractors Using Gasoline or L. P. Gas Fuel," **by M. J. Samuelson**, Minneapolis-Moline Co. . . . "The Role of Fuel in Engine Development," (Horning Memorial Lecture) by **D. P. Barnard**, Standard Oil Co. (Ind.) . . . "Motor Fuel Volatility Trends," by **W. M. Holaday** and **D. P. Heath**, Socony-Vacuum Oil Co., Inc. . . . "A New Look at Motor Gasoline Quality—Carburetor Icing Tendency," by **J. F. Kunc, Jr., J. P. Haworth,** and **J. E. Hickok**, Esso Laboratories, Standard Oil Development Co. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**



Sidney J. Williams (right) receives the SAE Beecroft Memorial Award from Pyke Johnson, president, Automotive Safety Foundation, who made the presentation for the Society. Williams, who is assistant to the president, National Safety Council, presented the Fourth Beecroft Memorial Lecture on "Traffic Safety and the World We Live In." . . . . Prepared discussions presented following the lecture included those by O. E. Hunt, General Motors Corp.; R. F. King, Massachusetts Registrar of Motor Vehicles; J. C. Kohl, University of Michigan; and Ralph Lee, General Motors Corp.

compression ratios going up. Broad aim of the high-compression engine program was said to be to make three oil wells serve where we now require four. But further advances in antiknock quality will have to come in small increments, warned petroleum men, because equal steps upward are becoming increasingly expensive.

Trend in new refinery processes means that as gasoline octane numbers increase, refiners no longer will have an incentive to produce more volatile gasoline. Efficient operation of these new processes was said to call for production of fuels having higher 90% points.

Average 90% point of motor gasolines is expected to rise to the 350 to 360 F level, with many fuels going to the 380 to 390 F range. The 50% point will decrease slightly, or hold its own. Increasing availability of volatile materials from gas processing portends an increase in initial volatility. Vapor pressures of all gasolines are expected to go up as rapidly as vapor-locking tendencies of cars and trucks will permit.

Accelerated use of LP gas as a fuel seems assured, said petroleum technologists, based on market data. Sales of LP gas conversion units for farm tractors alone exceeded 100,000 in 1950, more than twice the number sold in 1949. LP gas is a natural for farmers because it is used for water heating, stationary powerplants, house heating, and cooking, as well as a motor fuel.

Realistic appraisal of the fuel picture in the light of quickening military preparedness forecast a temporary halt to gasoline improvement. Should war come, the World War II pattern will be duplicated. Gasoline octane numbers will be reduced and high-octane components diverted to aviation gasoline and other products for the military.

The present military situation will result in lower vapor pressure gasoline in some parts of the country. An all-out emergency will drop vapor pressures and boost 50 and 90% distillation temperatures if demand for aviation gasoline is high. But if the chief need is for jet engine fuel, gasoline vapor pressures will not change or will increase, depending on characteristics of military jet fuel.

Vehicle engines with a thirst for extremely volatile fuel will appreciably cut yield of high-octane gasoline, warned a war-conscious engineer. Volatility-sensitive plane engines in some tanks during World War II made it tough for the military to get enough gasoline.

Reports on engine design trends quenched this fear and also promised some help on engine warm-up troubles. Recent tests showed that overhead valve engines are much less sensitive to fuel volatility than L-head engines. Since engine progress is headed in the overhead valve direction, most future engines will not require extremely volatile fuels.

Several oil men saw LP gas cushioning essential civilian economy against military wartime needs for aviation and motor gasolines. In fact, LP gas was labelled a potentially vital factor in extending our national petroleum reserves. Some said use of natural gas can help make each barrel of crude do the job of two.

LP Gas Evaluated

Petroleum and engine men added up both sides of the ledger on LP gas and came up with more pros than cons. But conclusions on net gains were indecisive except for certain cases.

LP gas proponents extolled the very high octane numbers of these fuels as one big plus value. Engines running on propane should be designed for compression ratios of at least 10 to 1, they said, for top efficiency. This should give a 15% gain in thermal efficiency compared with engines at conventional compression ratios.

Offsetting the high octane numbers of LP gas is its low specific gravity. This means low heat content per gallon. Propane has 92,000 Btu's per gal while average gasoline has some 120,000 Btu's per gal, or 27% less heat energy than gasoline.

Theoretically, an LP gas-burning engine, despite its 15% gain in thermal efficiency, would be on the short end in economy or mileage by 12%. But oil men find these fuels give much better mileage in the field than Btu content and thermal efficiency comparisons with liquid fuels would indicate. They believe improved manifold distribution and clean burning more than outweigh the 12% deficit.

Fuel consumption data disclosed greater economy with gasoline than LP gas at maximum and rated load. But at light loads and idling, LP gas is more economical. Two tractors of the same model were compared, with one burning gasoline and the other LP gas. Fuel consumption of the LP gas tractor was about 18% greater after 5000 to 6000 hr of heavy work.

Many farmers report they have reduced their maintenance expense and get longer periods between overhauls. Some say they can use rings, pistons, and cylinders twice as long as they do with gasoline. Southern plantation owners, in a favorable LP gas

rice area, conservatively estimate a 20% saving in maintenance cost.

At least three factors were seen negating these plus values of LP gas—need for added carburetion equipment, cold-starting troubles, and nonvolatile contaminants. And the price angle, too, was questioned.

Special equipment is needed for engines using LP gas. For carburetion, a withdrawal system must be added. Additional devices, too, are needed for starting, idling, and part-throttle control.

Another soft spot in the LP gas picture is complaints from tractor operators that it's harder to start with LP gas than with gasoline in cold weather. Cold room tests verified this fact of life. And all agreed that higher compression ratios will aggravate the problem.

LP gases containing contaminants also bring service gripes. Most contaminants remain in the heat exchanger after the LP gas is vaporized. They work their way into the pressure regulators and cause trouble.

Because they are gases, propane and butane are practically devoid of the voltatility and carburetor icing problems of gasoline. Despite the prominence given antiknock quality, gasoline volatility was shown to affect many more engine performance criteria.

D. P. Barnard, Standard Oil Co. of Indiana (right) receives the Horning Memorial Medal just prior to presentation of his Horning Memorial Lecture on "The Role of Fuel in Engine Development." The presentation was made by Mrs. H. L. Horning, sponsor of the Award, and A. M. Rothrock, chairman of the Horning Memorial Board of Award

For example, initial volatility, known as the 10% or 20% point, influences vapor lock, starting, and evaporation. Average volatility, temperature at which 50% of the fuel is evaporated, affects warmup, stalling, and acceleration. Fuel economy, crankcase oil dilution, and engine cleanliness depend on the final volatility—temperature at which 90% of the fuel is evaporated.

The growing severity of stalling in recent years focused attention on its causes and cures. Engineers traced it to an icing effect. Trying to idle the engine before it is thoroughly warmed up in cool and wet weather causes frequent stalling and flaring of motorists' tempers.

It stems from rapid evaporation of extremely volatile fuels in the carburetor throat. Under proper atmospheric conditions, the evaporation freezes out some moisture in the intake air. If this ice collects on the wall and throttle plate and covers the idle bleed hole, the engine will stall when the throttle is closed. But the engine can easily be restarted because ice melts almost immediately after a stall due to residual heat from the exhaust manifold. Also, normal starting procedure involves additional opening of the throttle.

Best way found to ease the icing troubles, several petroleum men reported, is to use additive in the gasoline. These anti-icing agents minimize ice formation without creating performance problems of their own.

Conflicting Views on Volatility

Full responsibility for getting better coordination of fuel volatility and engine needs shaped up like "The Thing," during and between sessions. Running controversy between engine and fuel men on who should do what ended in agreement on only one point . . . both should do something.

Petroleum engineers said vehicle builders must make their product more tolerant to higher vapor pressures. This, they suggested, can be done in

Session Chairmen

The 1951 SAE Annual Meeting was planned by the 1950 SAE Meetings Committee and the 12 Professional Activity Meetings Committees.

The 1950 Meetings Committee operated under the general chairmanship of G. A. Delaney and included L. W. Fischer, vice-chairman; W. K. Creson, Robert Insley, G. W. Laurie, R. R. Teetor, and the Meetings Chairmen of the 12 Professional Activities.

Chairman of the technical sessions of the meeting were A. H. Fox, Standard Oil Co. (Ind.), Whiting; R. D. Kelly, United Air Lines, Inc., Denver; C. G. A. Rosen, Caterpillar Tractor Co., Peoria; H. L. Brock, Ford Motor Co., Dearborn; L. A. Rodert, National Advisory Committee for Aeronautics, Cleveland; D. F. Caris, General Motors Corp., Milwaukee; R. J. Woods, Bell Aircraft Corp., Buffalo; A. O. Willey, Lubrizol Corp., Cleveland; B. R. Teree, New York Air Brake Co., Watertown; R. F. Steeneck, Fafnir Bearing Co., New Britain, Conn.; E. H. Smith, Packard Motor Car Co., Detroit; A. L. Pomeroy, Thompson Products, Inc., Cleveland; James C. Zeder, Chrysler Corp., Detroit; Fredric Flader, Fredric Flader, Inc., North Tonawanda, N. Y.; J. L. McCloud, Ford Motor Co., Dearborn; W. P. Michell, Dana Corp., Toledo; H. H. Hooker, Eaton Mfg. Co., Cleveland; F. P. Zimmerli, Associated Spring Corp., Detroit; E. C. DeSmet, Willys-Overland Motors, Inc., Toledo; M. E. Nuttila, Cities Service Oil Co., New York; J. W. Greig, Woodall Industries, Inc., Detroit; A. H. Deimel, Dana Corp., Toledo; J. A. Harvey, Pittsburgh Motor Coach Co., Pittsburgh.

three ways: (1) shielding the fuel system and components from heat, (2) using pressure-type gasoline tanks and caps, and (3) using a fuel pump at or in the fuel tank.

Higher vapor pressure fuels will increase both availability and octane-number level of gasolines, explained oil men, and such gasolines should be used efficiently. Trend toward such fuels will ease starting, but will intensify vapor lock and even create an evaporation loss problem.

A vehicle engineer differed radically with this thinking. To him, this approach meant "that the motor manufacturer should add higher cost components to his product so that the petroleum manufacturer can utilize some of the lower cost items in his product." Adding pressure fuel tanks, tank-mounted fuel pumps, and improved carburetors, he said, permits the oil refiner to use the lower volatility ends of the refining processes.

Evaporation losses average about 2.7 gal per year per car which costs the motorist 70¢. Pressurized equipment would cost much more and would also produce a fire hazard.

Another engine man also viewed oil industry recommendations with misgivings. "It means," he said, "that the automotive industry will proceed to design and incorporate a supplementary refinery under the hood of each vehicle. This supplementary refinery will serve to finish the gasoline coming from the major refinery, and thereby make it even more excellently suited to the engine requirements as regards performance and efficiency."

From these and other arguments emerged agreement that the petroleum refiner should try to produce gasolines not deviating widely from average characteristics. This should ease the automotive manufacturer's job. Fuels more uniform in volatility characteristics should permit design of more reliable and higher performance cars. But keep fuels volatility appetites of your engines close to the average, oil engineers told vehicle men, if our common goals are to be realized.

IGNITION SYSTEM Developments Promise Improved Performance

Based on discussions and three papers presented at one Passenger Car session . . . "The Smitsvonk Low-Tension Capacity Ignition System," by **W. Beye Smits** and **P. F. H. Maclaine Pont**, Smitsvonk N. V. Research Laboratory . . . "Ignition Problems in Damp Weather," by **H. L. Hartzell** and **B. H. Short**, Delco-Remy Division, GMC . . . "Optimum Rate of Voltage Rise for Minimum Energy Loss in Ignition Systems," by **L. H. Middleton** and **M. F. Peters**, Electric Auto-Lite Co. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

PRESSED by an obvious need to make ignition systems more reliable in all weather conditions, and particularly to make them meet the demands imposed on them by high compression engines, researchers have been making real progress by varied routes, it was revealed.

The amount of electrical energy available for an ignition impulse isn't so great but that a small amount of water in any concentration can bring an engine to a stop. Most troubles arise from rain or splash, conditions of high humidity, or from condensation of moisture from crankcase vapors inside the distributor cap. These troubles can be overcome by relatively simple means, one speaker indicated. Five steps were outlined which have proved effective for all conditions save those of submersion of very heavy splash. These are:

1. Replace braid-lacquered covered cables with neoprene-covered cables.
2. Install tight-fitting durable nipples on all towers of the distributor cap and on the coil output terminals.
3. Install tight-fitting durable nipples on all spark plugs.
4. Provide adequate distributor ventilation.
5. Replace distributor cap and rotor with units having their contouring designed to minimize the effects of moisture.

One discusser advised keeping the amount of air trapped within the spark-plug nipple as small as possible, and suggested that adequate protection can be had if no more than half the spark plug's exposed insulator is covered.

Waterproofing, however important, was shown to be only one factor in the problem of making ignition systems yield better performance. Speakers and discussers were more concerned over the failure of present systems to handle engines with higher compression ratios, O.H.V. engines, and engines with specific output stepped up by using higher rpm. They thought ignition might prove to be the bottleneck in getting maximum performance. We are, said one speaker, rapidly approaching the minimum performance requirements of the present-day distributor and coil-type ignition systems.

That engineers are aware of the difficulties encountered when compression ratios are raised is evidenced by steps taken to overcome them, such as the use of double contact breakers and dual coils. And they also recognize the need for special ignition when rpm are stepped-up, as witness the designing of special distributors. But the meeting made obvious that there is no solid agreement yet as to how best to surmount difficulties.

Two approaches to the problem of improving ignition were discussed: one involves modifying the existing high-tension system, the other would substitute a low-tension one.

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Among Those at the Speakers Table . . .

1 F. M. Zeder, vice-chairman of board, Chrysler Corp.
Major-Gen. E. E. MacMorland, commanding general, Aberdeen Proving Ground
E. F. Fisher, president, Gar Wood Industries

2 L. C. Goad, executive vice-president, General Motors Corp.
Major-Gen. E. L. Ford, chief of Ordnance, Department of Army
S. W. Sparrow, vice-president in charge of engineering, Studebaker Corp., and chairman, SAE Technical Board

3 G. W. Mason, president, Nash-Kelvinator Corp.
Lt.-Gen. T. B. Larkin, assistant chief of staff, Department of Army
H. J. Klingler, vice-president, General Motors Corp.

4 R. T. Hurley, president, Curtiss-Wright Corp.
Major-Gen. W. H. Maris, deputy assistant chief of staff for research & development, U. S. Army.
R. L. Biggers, president, Fargo Division, Chrysler Corp.

5 C. J. Reese, president, Continental Motors Corp.;
Brig.-Gen. A. G. Johnson, chief, industrial planning division, Air Materiel Command
L. L. Colbert, president, Chrysler Corp.

6 H. M. Horner, president, United Aircraft Corp.
Glenn L. Martin, chairman of the Board, Glenn L. Martin Co.
Rear-Admiral A. M. Pride, chief, Bureau of Aeronautics

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The present primary current limitations imposed by the high-speed primary circuit breaker mechanism limit the total amount of energy available, while increases in top speed of O.H.V. engines reduces the duration of the primary excitation to a degree where it becomes necessary to improve the efficiency of the overall system substantially to meet these new demands. Unless a means can be found to justify the reduction of the so-called utility value of the spark, said one researcher, it will become necessary to increase the energy output by increasing the primary current, thus shortening the life of the breaker points and limiting the long-term usefulness of the system.

A solution reached through studies and presented at the meeting is to limit the rate of voltage rise to a range of predetermined values. Thus a large part of the energy now reserved for the utility component can be used for charging the secondary circuit to a higher voltage, without decreasing the probability of sparking. Equations for determining these values were presented.

The troubles engineers are running into, and which give rise to work to develop a low-tension system, are many. There is, for example, the 8 to 10% increase in plug voltage caused by each increase of one whole compression ratio. Use of double-contact breakers and dual coils no more than postpone reaching the region of the critical margin, it was claimed. Again, with engine development goes a trend toward use of larger valves leaving little room for plugs, but plugs cannot be made indefinitely smaller because of their insulating requirements. In the field of aviation the troubles become even more pronounced with the advent of the jet engine. Here, the high air velocities, the cleaning and cooling of the high-tension igniter plugs, and the re-lights during high-speed flight, pose serious difficulties.

One system proffered as a solution to ignition problems uses a relatively low tension throughout. The sources of electrical supply can be magnetos, coils, or direct current. Contact breakers are done away with, their function being taken over by a low-tension distributor. The sparking element is a separate unit, which can be fitted into different sizes of plug bodies.

Many advantages are claimed for this low-tension system, notably: that it employs a universal spark plug suitable for any kind of internal-combustion engine, and that fouling actually improves its performance. It will ignite any fuel, and sparking is not rendered less efficient by deposits of impurities or soot. Given suitable condenser capacities it will ignite bituminous fuels such as tar. And that drop of water, the bane of existing systems, has no influence on this low-tension system. It will function normally when completely submerged in water.

This system attracted keen attention, particularly from aircraft engineers who were told that a special construction under test with jet engines showed that ignition could be effected at very low fuel pressures (8 psi) with high combustion air speeds (2.5 lb/sec), thereby eliminating any explosive effect which might damage turbine parts. In this construction fuel is fed directly to the sparking surface and two condensers of different capacities are used.

In discussion it was claimed that this low-tension system opened the way for the redesigning of engines. In the present-day engine, throttling and heat losses are the penalty paid for stabilizing combustion conditions by turbulence, and this, it was said, can be eliminated due to the violent energy release of the low-tension system.

DIESEL ENGINE Problems of Operation Get Practical Answers

Based on discussions and four papers presented at two Diesel Engine sessions and one Fuels and Lubricants session . . . "The Low-Temperature Starting and Operation of Diesel Engines," by **A. W. Sloan, A. C. Scurlock,** and **D. P. Herron,** Atlantic Research Corp. . . . "Combustion Characteristics of Diesel Fuels as Measured in a Constant-Volume Bomb," (A report of the Coordinating Research Council, Inc.) by **R. W. Hurn** and **K. J. Hughes,** U. S. Bureau of Mines . . . "The Current Status of Automotive Diesel Engine Design and Performance in Great Britain," by **C. B. Dicksee,** A. E. C., Ltd. . . . "Series 2 Oils Pay Their Way," by **W. G. Brown** and **F. E. Kronenberg,** Caterpillar Tractor Co., and **J. A. Edgar, F. A. M. Buck,** and **J. M. Plantfeber,** Shell Oil Co., Inc. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

DIESEL ENGINES were discussed at the meeting in terms of practical solution to operating problems . . . how to reduce wear, how to use the new Series 2 oils to best advantage, how to operate engines in cold weather, how to improve fuel economy.

Two widely differing views were expressed about how to reduce cylinder wear.

British operators, according to an English diesel-engine representative, think the whole answer should lie in improved engine design. A Dutch engineer, on the other hand said Hollanders have found much advantage in use of heavy-duty oil.

The design-improvement route does reduce wear under British conditions, it was argued, because operating conditions there are mild. Cylinder wear is low to begin with and detergent oils have not come into general use. In Holland, the heavy-duty oils are advantageous because engines there are faced with heavier tasks. British researchers, on the other hand, said that limited test work under British operating conditions indicate that detergent

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Speakers at the Dinner

Left to right: L. I. Woolson, Detroit Section Chairman; Henry Ford II, master of ceremonies; Archibald S. Alexander, chief dinner speaker; James C. Zeder, 1950 SAE President; Dale Roeder, 1951 SAE President

MORE than 2300 members and guests heard Under-Secretary of the Army Archibald S. Alexander promise industry 2 to 2½ billions per month of Army contracts for the next few months at the 1951 Annual Meeting Dinner at the Masonic Temple on Wednesday, Jan. 10. Alexander was the chief speaker at the gathering, where Henry Ford II, Ford Motor Co. president, acted as master of ceremonies.

1950 SAE President James C. Zeder, in a brief talk, emphasized the continued education and upgrading of America's great pool of technically trained young men as a major element in preparedness. In this respect, Zeder said, Russia has not been able to copy us successfully, and he urged that precautions be taken to guard and strengthen this potent resource.

Roeder Stresses War Aims

1951 SAE President Dale Roeder stressed SAE's readiness for the war mobilization tasks which probably lie ahead. "We are already in, or on the brink of, another emergency, which calls for curtailment of production of peacetime materials to establish volume production of war materiel. The SAE is already acting in an advisory capacity to some of our military people.

"Many of the problems which will be coming up due to this change can best be met by calling upon all the skill and ingenuity of the industry as a whole, which can best be accomplished through SAE.

"There is in this audience more real engineering knowledge of all types of automotive products, their design, production, and service problems than is gathered anywhere else in the world at this moment. . . . SAE will again render every assistance it can within the scope of its functions during 1951."

Detroit Section Chairman Irving Woolson opened the dinner proceedings with a welcome to Detroit to the members and guests. Mentioning the meeting as the SAE's first in the second half of the 20th century, he revealed that, inside of four short years, SAE will itself be celebrating its Silver Anniversary.

$5 Billion Already At Work, Alexander Says

"In the current fiscal year," Alexander stated, "the Army has put to work in the form of contracts and letter orders with American industry, and production orders with Army arsenals, more than $5 billion." Then he continued:

"But this is only the beginning. The Army's goal now is to make further contracts with industry of at least $2 to $2½ billion a month during the remainder of this fiscal year.

"... We will create a capacity to make 35,000 tanks a year. And the same will be done in other items of equipment and supplies.

"Of the $9 billion, 200 million voted for the Army last week, 6 billion, 500 million is for tanks, motor vehicles, guns, spare parts and other 'hardware.' Thus the ratio of such procurement to other items has become more than 70% of the whole as compared to less than 14% before initiation of the accelerated defense program.

"It is not necessary," he concluded, "to ask for your help. We know that you are eager to give it, as soon as it has been made clear what is needed of you."

Continued from Page 62

oils won't cut costs sufficiently to pay for the increased expense of the oil. Also working against detergent oil use in Britain is the fact that many operators reclaim their oil. It is common to use a 50-50 mixture of new and reclaimed oil.

Other data revealed at the meeting indicated that the English get a low rate of wear with normal oils, despite an increase in sulfur content in postwar fuel. The reason, according to one British statement, is chiefly because the alloy irons used in British cylinder liners have relatively high phosphorus content . . . and tests indicate that phosphorus ups corrosion resistance of iron greatly.

The American viewpoint expressed at the meeting pretty well coincided with that of the Dutch. Operating conditions in United States generally are much more severe than in England, it was agreed, and engine design improvement can't accomplish sufficient results alone.

Increased output and stepped-up speeds were reported as making the engine designer more and more dependent on high-quality lubricants, in his efforts to keep cylinder wear within reasonable limits.

Latest step is the Series 2 oil, which has a considerably higher additive content than the 2-104B oils.

It was generally agreed that, although these oils cost more, they "pay their way," because they have remarkable wear-reducing qualities.

It was reported, for example, that under severe conditions these oils will produce wear rates no greater than those of 2-104B oils when the oil change interval is extended 500%. Under some mild conditions, it appears possible to extend the oil change interval with Series 2 oils indefinitely, considering corrosive wear alone.

The measures taken to provide suitable winterization must meet the following conditions, according to a survey made for the Navy:

1. No interference with satisfactory operation at normal temperatures.
2. Equipment and materials required must be available at a reasonable price.
3. Operation simplicity must be retained so that untrained personnel will need only a brief training period.
4. Overall space requirements should not be unduly increased.
5. The danger of fire or explosion must not, under any circumstance, be appreciably increased.
6. Safety features and automatic controls must not involve the introduction of delicate equipment.

It seemed to be agreed that if No. 1 is to be met, with success, for – 65 F starting, external heat would have to be applied.

One discusser suggested, however, that this would best be attained with an auxiliary gasoline heater, which actually would conflict with No. 5, as it would obviously be dangerous. As an alternative, he suggested a gasoline engine installed as part of the engine, to be used as both a heater and a cranking motor. He pointed out that this method would be less dangerous—and also less successful—as a quick warmup device.

He thought the least fire hazard would probably always be associated with a quick pushbutton start, such as that obtained with electric hydraulic, and cartridge cranking.

It was suggested that the best low-temperature lubricants, if it weren't for their high cost and lack of availability, would be the synthetic types. But some thought synthetics are not too satisfactory.

One way of lowering the viscosity of the lube oil for cold-weather starts, it was said, is to dilute the oil with gasoline before shutting down the engine. This is common practice with gasoline engines, but it appears to have disadvantages for diesels: It requires carrying another liquid. It presents a fire hazard. It is difficult to control. Further, it may have detrimental effects on the property of the lubricant.

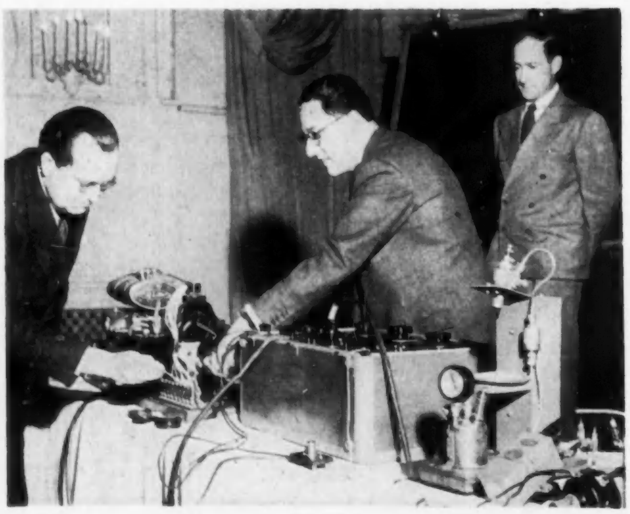
One answer suggested would be the use of a nonflammable diluent, such as fluorocarbon, and a small condenser to recover the vapors as they exhaust through the crankcase vent. In any case, the diluent must be thoroughly mixed throughout the engine.

Attainment of low fuel consumption has almost become an obsession with British designers and operators, a British engineer remarked, because of the high cost of fuel.

Mainly for this reason, he said, the British have adopted the open combustion chamber. They feel that it is most efficient for several reasons:

1. It dispenses with an intermediate stage in the combustion process, burning the fuel directly from the liquid state.
2. It does not reserve part of its fuel supply for burning at a relatively late period in the cycle.
3. The heat carried away in the coolant is reduced to a low figure.

Better utilization of available fuel was also the reason behind the development of the constant-volume bomb, which was covered in a CRC report



Merits of the Smitsvonk low-tension capacity ignition system operating with a two-cycle engine are demonstrated by J. J. Broeze (left), Royal Dutch Shell Laboratory, and P. F. H. Maclaine Pont (center), Smitsvonk N. V. Research Laboratory. Dr. A. G. Cattaneo, Shell Development Co., helped the demonstrators. Spark plugs were shown to fire both when fouled and with ignition wires submerged in water

presented at the meeting. With this bomb the combustion characteristics of fuels can be studied. It was developed by the Bureau of Mines Petroleum Experiment Station in cooperation with the Diesel Fuels Division of CRC. The project was started shortly after World War II, when it appeared that fuels suitable for high-speed diesels would not be adequate to meet the demand.

At that time, according to the report, it was thought that these engines could not digest, without undesirable sacrifice, certain stocks that were believed to represent the greater percentage of fuel available for the diesel market. The intelligent appraisal of the situation as regards better utilization of the available fuels required factual data concerning combustion characteristics of the specific fuel components.

Researches resulting from this demand called for some method of obtaining a significant measure of the ignition quality of narrow-boiling cuts and samples available only in extremely small quantities.

The constant-volume combustion technique both meets the demand for a small-sample technique and allows the comprehensive investigation of the combustion characteristics of a fuel over wide ranges of operating conditions, according to the report.

Automotive Engineers Said to Favor Empirical DESIGN METHODS

Based on discussions and eight papers presented at one Aircraft session, two Engineering Materials session, one Truck and Bus session, and one Pasesnger Car session . . . "The Accessory Manufacturer's View of Field Service," by **P. H. Emrich**, Vickers, Inc. . . . "Automotive Applications and Special Features of Synthetic and Natural Rubbers," by **J. W. Liska**, Firestone Tire and Rubber Co. . . . "The Automotive Differential," by **L. Ray Buckendale** and **L. G. Boughner**, Timken-Detroit Axle Co. . . . "Operational Stresses in Automotive Parts," by **Robert Schilling**, Research Laboratories Division, GMC . . . "Engineering of the Involute Spline," by **G. L. McCain**, Chrysler Corp. . . . "Gear Serviceability," by **J. O. Almen**, Research Laboratories Division, GMC (presented by R. L. Mattson) . . . "Planetary Gears for Automatic Transmissions," by **D. T. Sicklesteel**, Borg-Warner Corp . . . "Stresses Imposed by Processing," by **O. J. Horger**, Timken Roller Bearing Co. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

BUILD-IT-AND-BUST-IT testing, in both laboratory and field, has been the best way to find the right shape and material for automotive products. That's how most automotive engineers argued at the meeting as they upheld the empirical as against the theoretical approach to design.

"You can't design automotive parts by the textbook. . . Grinding out design answers from formulas alone doesn't bring best results." Men from the industry chorused those sentiments at more than a few sessions. "Practice precedes science," is the way one engineer put it. Others stressed that many data still must be unearthed in trial by test before reducing automotive design to mathematical behavior patterns.

But before the meeting ended, automotive engineers took the steam out of a long-standing accusation. It's said they pay little attention to stress analysis in designing parts and components, depend too much on rules of thumb and cut-and-try methods to achieve strength and durability. They admitted using more empirical information and less analysis than in most mechanical engineering, but showed good reason for it.

"We select design stresses that aim for freedom from failure below a limited load and for a finite life," automotive men said. "We expect failures under extreme overload, but try to prevent unsafe failures."

They admitted hardly ever knowing the true stress which exists in their products in service. But they do know that parts and components will stand up in reasonable usage for life of the vehicle.

Automotive design practice was said to begin with observation of failures either in service or in laboratory test. This brings empirical expressions relating nominal stresses to the material's characteristics. Such a relation applies only to one type of service. Yet despite these restrictions, such information may be extrapolated to applications which at first may seem totally unrelated.

Proof of the pudding, argued motor vehicle designers, is that many marine, railroad, and ordnance vehicle developments were based on passenger-car practice and have proved satisfactory.

Residual stresses too, imparted by most all manufacturing processes, defy scientific evaluation, automotive men heard. Both mechanical and X-ray methods throw some light on internal stresses.

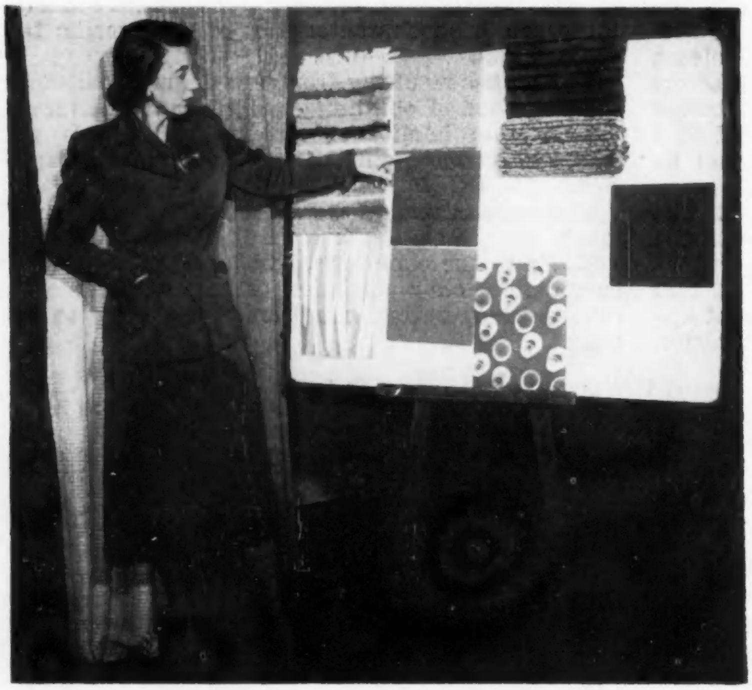
X-ray analysis detects only elastic stresses, those in the surface layer. In the mechanical boring-out method, a shaft specimen—with strain gages cemented on the surface—is bored in steps. The bored shell also is cut and slit longitudinally. Length and diameter changes measured with the gages permit calculation of residual stresses in three principal directions.

These experimental techniques revealed residual stresses to be beneficial. When in a favorable direction, these stresses help extend fatigue life of a part by working against service-imposed stresses.

Gear designers too supported the empirical method. Lab data plus service records on thousands of gears in service produced useful formulas. "Let the gears tell us what they can or cannot do," said one engineer.

Conventional methods satisfy gear design for heavy industrial and marine equipment. But such gears are grossly overdesigned, use too much material, take too much weight and space. The more than two million gear histories studied by one gear research group yielded fatigue life criteria and ways to predict scoring.

Selecting the right material compound for a part,



MARIANNE STRENGELL, Director of the Weaving Department of Cranbrook Academy of Art and well-known designer of fabrics, is shown here with some of the fabrics she has designed. Under the chairmanship of J. W. Greig, she discussed "Automotive Fabrics from the Creative Viewpoint."

She called for the use of more imagination in the design of fabrics for automobiles. Using the 1950 cars as examples, she said that the upholstery fabrics were all very handsome, subdued, and easy to live with. But, she added, there is too much similarity in fabrics and their treatment by the various car makers—and they are not practical.

She believes that if a creative designer could design the fabrics used, there would be more individuality and beauty in the upholstery and, at the same time, it would be more stainproof, fireproof, and have higher tensile strength than those now used.

like the stress analysis determination, is impossible based on theoretical considerations alone. Rubber was cited as a case in point. Despite the growth of fundamental knowledge relating rubber's mechanical properties, little of it has been translated into engineering usefulness.

Automotive design engineers were urged to cooperate with rubber manufacturers before selecting a given elastomer or compound for a specific use. That's because creation of successful rubber products still depends on a combination of compound improvement, empirical data, cut-and-try methods, and extensive end-product testing.

The experience accumulation on the product continues even after it hits the market, said automotive engineers, if we're to achieve continued improvement. Customers' complaints were labelled a valuable index to product shortcomings.

Engineers agreed that no known pretesting system shows up all the bugs in a product. But few deficiencies escape the cost-conscious eye of the customer. Repeated complaints should move engineering and production departments to remedial action.

The first-find-out-if-it-works technique of engineering proved to be an integral part of industry standards-making too. Achievement of the recent American Standard for involute splines, also an SAE Standard, was credited to an 11-year buildup of industry experiences.

As production and engineering difficulties with the first involute spline standard, published in 1939, came to light, changes to overcome them were tried. From actual usage came data on needed fits and tolerances, sizes and dimensions. From the experience of many emerged a significant tool for all, the current Standard.

Automotive design methodology's pay-off is in the products it spawns, its practitioners showed. Discussions of how specific parts and components were born of these engineering techniques further solidified agreement on the empirical design approach.

Observing the part's performance in both lab tests and field service helps the automotive engineer build a satisfactory life into his design. Too, the part has little excess weight and material.

Such studies help motor vehicle engineers classify parts into three groups: (1) those subject to static failure (under a single load failure); (2) those subject to fatigue failure (under repeated load cycle); and (3) those subject to either static or fatigue failure.

Some parts in the first group will not be subject to load reversal. Parts in this group—axle forgings and housings—must have static load stress a fraction of the yield strength. Steering gear and linkage are typical of first-group parts that are subject to load reversal. They will fail only by permanent deformation under collision loads.

Parts that fail by fatigue also are subject to nonreversing loads (transmission gears and splines) and fully reversing loads (crankshaft and crank mechanism). Third-group parts, which may fail statically or in fatigue, include leaf springs on Hotchkiss drives, suspension coil springs, axle shafts, front-wheel spindles, knuckles, and kingpins.

Lab researches also showed how to get the favorable residual stresses. In one case quenching in water from the temper showed a 29% increase in endurance limit over cooling in air, and 52% in another part.

Designers accepted this as a way to get "something for nothing." Just by switching the afterquench method, a given amount of material in a part can be made to do more work. For this purpose, water is the best method of cooling from temper, with oil, air, and furnace cooling next.

One engineer reported that increased fillet radius often will get more work from a part than increased cross-section. Sharp corners are stress raisers. They are commonly left by spot-facing, milling, and other machining operations. Introducing appreciable fillets cuts down stress concentration and extends endurance limit.

Empirical methods also pay off in planetary gears for automatic transmissions, showed a gear man. He estimates full-throttle life requirements, converts it to stress cycles, lays out the gears, and makes several trials before final design. Result: smallest and strongest gears for the job. It saves materials too because the gear's full strength is developed. In fact, no safety factor is used for the bending fatigue data reflecting desired service and life expectancy.

The military preparedness atmosphere permeating the meeting brought out in sharp relief these materials conservation aids. Seriousness of the materials situation was brought home by reports of SAE technical committee work in evaluating critical materials in Army vehicles for Ordnance.

From cut-and-try methods to satisfy specific service requirements have emerged nearly 200 separate rubber products for the 400 or so rubber parts in the modern passenger car. Giving the rubber technologist latitude in developing the compound, without restrictions on choice of rubber (provided it qualifies under service conditions) produced good results in radiator hose, fuel and oil hose, fan belts, brake hose, and tires.

The merit of keeping an ear attuned to field service complaints was proved in a chassis design problem. When wishbone-type front suspensions first were introduced, the shock absorber and its arm formed the upper wishbone. Although satisfactory in normal service, this construction brought complaints of frequent collision damage. The assembly was redesigned to withstand a longitudinal horizontal force of about 3000 lb before permanent set, which put a stop to the trouble.

Another engineer reported that during the war, Sperry Gyroscope Co. discovered through its service organization that one of its intricate devices wouldn't operate in the desert without cleaning every 20 hr. A simple design change made the instrument practical.

Engineers said they abandoned the straight or parallel type in favor of the involute spline because experience proved it is easily manufactured by several processes, requires a minimum of tools, ordinarily does not need to be ground, is self-centering, and carries maximum power because of a fillet at the spline tooth root.

The new standard, adopted by SAE in 1949 and by ASA in 1950, greatly simplifies manufacture of involute splines. The engineers who developed this standard, previously revised in 1946, have added tolerances which cover unavoidable manufacturing errors. This gives manufacturing control that facilitates mating of external and internal splines. Without these allowable errors, parts made even in the same factory sometimes would not assemble with desired clearance without hand fitting.

Despite the progress to date with their techniques, automotive engineers were quick to point out that basic problems still challenge them. The automotive differential is a case in point.

Partial remedies have been devised. Still unreached is an answer that satisfies all demands under all the conditions in which driving wheels may operate. "Maybe what we are looking for is a mechanical or electronic brain," mused one differential specialist, "but no one has yet figured out how to put this together, with the machinery that it would actuate, inside the space limitations of an automotive rear wheel."

Better Equipment Improves Highway Transport Vehicle REFRIGERATION

Based on discussions and two papers presented at one Truck and Bus session . . . "Refrigeration of Delivery Vehicles," by **W. E. Petersen**, International Harvester Co. . . . "Refrigeration of Highway Transport Vehicles," by **V. M. Drew**, Fruehauf Trailer Co. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

RESEARCH to improve equipment for refrigerated motor transport is proceeding along three lines—to raise the efficiency of truck bodies, to refine methods of using power from the truck engine to produce the refrigeration, and to perfect independent refrigeration systems for trucks, experts in this field revealed.

Compact, light-weight, and reliable refrigeration equipment has become an absolute necessity now that more than 65% of all currently consumed food items classed as perishable or semi-perishable, and its importance is growing, it was pointed out, as the use of frozen foods expands.

Refrigerated foods fall roughly into three classifications: One group needs only a comfortable room temperature, one requires a near-freezing temperature, while the last, embracing all frozen foods, has to be held at close to zero. Most of the problems with which shippers have to contend arise when there is need to exercise a narrow range of temperature control, particularly on a long haul.

Condensation due to humidity and temperature differentials was called the bane of the body designer and the transport operator. To overcome this it was suggested that "weep holes" be placed along the lower side or bottom of the side walls. Dampness also raises havoc with body floors, hence preference is being given to metal rather than to plywood when conditions are severe. Extrusions of magnesium, aluminum or preformed stainless

steel, given a contour, which provides longitudinal troughs for disposal of water, are now finding ready acceptance. Such design flooring has the added advantage of permitting under-load air circulation.

It was pointed out that highly polished metal body panels have a higher degree of thermal efficiency if left unpainted, but that if painting is necessary light colors should be used. This comment aroused considerable discussion. One operator maintained that painting made no difference as far as his tests could reveal, while another declared that tests with thermocouples showed a difference ranging from 20 to 30%. Further discussion revealed that little testing had been done of a definitive nature. In this connection it was suggested that an instrument for tape recording of refrigeration performance of vehicles on the road would be well worth developing.

That refrigerated transports are built to maintain temperatures and not to serve as icing plants, was another point stressed by a discusser. When precooling is not practiced, it was said, refrigeration may be inadequate and the operator then blames the cooling mechanism or the body insulation. Pre-cooling can be done faster when body interiors are made of light metal than when plywood is used, it was stated.

Use of engine power for refrigeration has been practised for many years and has proved satisfactory where semi-perishables are to be hauled, but there was agreement that getting a constant pressure from an engine operating at varying speeds constituted a real problem. Hydraulic and magnetic clutch systems have been devised to overcome this drawback and it is in the improvement of these devices that research is now engaged.

That independent automatic refrigeration units are better than ice or hold-over installations when a narrow temperature control is a requisite, was generally agreed. The independent unit is more compact and more dependable because temperatures do not decline over a long haul. The trend is toward using liquid rather than aircooled engines to power these units in order to gain greater dependability, even though it may mean adding slightly to weight.

MOTOR TRANSPORT

Operators Search for Maintenance Cost Cut

Based on discussions and two papers presented at two Transportation and Maintenance sessions . . . "Maintenance Savings Accomplished through an Integrated Plan of Precision Testing and Adjustment to Manufacturers' Standards," by **A. W. Neumann**, The Willett Co. . . . Mechanizing the Garage and Shop from an Economic Standpoint—"Daily Servicing": **W. L. Bennett**, Baltimore Transfer Co.; "Preventive Maintenance and Routine Running Repairs": **Linn Edsall**, Philadelphia Electric Co.; and "Repair and Overhaul": **H. H. Earl**, United Parcel Service of New York, Inc. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

MOTOR TRANSPORT operators are making a determined effort to reduce the cost of maintenance, but it was apparent that they are not in accord as to how to accomplish it. However, this very lack of unanimity served to reveal a widespread agreement, namely, that the conditions facing each operator differ and that the problems arising therefrom can be solved only by thorough analysis of individual conditions.

A common note was struck for those who had been in business for many years when the statement was made that vehicles had become more complicated with the years, hence there was greater need for control of costs since man-hours tended to rise. Cited among items adding to service were oil bath oil cleaners, hydrovacs, and, also, inaccessibility created by styling.

Proper methods and procedures may very possibly produce as satisfactory results as the use of certain mechanical equipment, said one operator. Where the operation involves light vehicles for city delivery as well as heavy-duty trucks for long hauls, he suggested using automatic shut-off nozzles on gasoline pumps as being more practical than high output pumps, because of excessive spillage. Under similar conditions it may prove more satisfactory, he said, to pump oil directly from barrels by hand than to go to the expense of installing equipment to dispense several grades of oil, particularly if the fleet is scattered.

Discussion as to what equipment to have in a shop centered on the relative merits of hoists versus pits, and, again, this emphasized that operating conditions were the determining factor, since no formulation could be reached that was universally acceptable. One operator advocated a high degree of instrumentation for testing, to hold vehicle operation to manufacturers' specifications, while another operator urged experimentation to arrive at one's own optimum. However, both discussers agreed that it was essential to make a correct diagnosis by whatever means available lest service work be wasted.

The way economies may be effected by studying individual operating conditions was well exampled by the experience of one operator who told of checking items listed for frequent inspection only to find money being wasted in excess maintenance. But, worse than that, the listing of unnecessary work led service men to disregard instructions and eventually to neglect necessary work. The desire for perfection, said another operator, must be restrained in the light of high productive hour costs, and a little

less efficiency is preferable to over-maintaining and over-equipping the shop.

It was obvious that operators regard PM as a means for keeping vehicles out of the shop and this they are keen to do, but again, they go about it in different ways. One operator told of classifying work to fall into two inspection periods: one to be performed at 1000 to 1500 miles, the other at 6000 miles. A mobile inspection and maintenance unit was then developed for dispatching into outlying areas where the trucks were garaged, there to be used for the 1000-mile period, thus eliminating the need to bring trucks into the shop for anything but the long interval checkup.

Another operator, striving to the same end—to keep trucks away from the shop "where it costs even to move them from place to place"—described as one step to lengthen checkup intervals the use of an expensive grease. By switching to a grease that would give satisfactory service for a longer period, even though more costly, there was a saving in labor costs.

When it came to a question of keeping service records, opinion differed as to the scope and detail required. A strong plea was made for keeping all records and forms as simple as possible because, as one operator put it, shop men are neither trained for nor interested in doing paper work.

In training men for service work, said one operator, younger men respond better than older ones. Several discussers corroborated this statement and all urged that training programs be set up since good mechanics were no longer to be found easily.

THE PREPRINT BOOTH was active every day. L. D. Thompson (left) was an early buyer before the crowd descended. SAE Enrolled Student Dick Diller of Detroit Institute of Technology is the man behind the counter

Let's Have Even More Safety Say Engineers at Sessions on AIR TRANSPORT

Based on discussions and three papers presented at two Air Transport sessions . . . "Air Transport Developments 1949-1950 and a View to the Future," by **R. D. Speas**, A. V. Roe Canada, Ltd. . . . "Some Developments for Safer Aircraft," by **A. L. Morse**, Civil Aeronautics Administration . . . "Observations on Flight Safety," by **Jerome Lederer**, Flight Safety Foundation, Inc. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

A COMMENDABLE job has been done to make flying safer, but an even better job remains to be done and must be done. This was the common expression of the meeting, apparent even in the undertones and overtones. Varied approaches were made to the subject of air safety, which served to clarify the problem, while reports presenting what was being done gave assurance of further progress.

Accidents have a profound effect on public confidence which is reflected in revenue and development of air transport, it was stated. Their prevention should be regarded as much of a business transaction as any financial deal that calls for the close attention and best brains of management since it involves the protection of capital or the realization of profit. As one speaker put it bluntly, the airlines cannot afford the present loss of equipment the investment in trained personnel, the liability suits, and the hull losses.

In support of this contention that accidents cause a serious setback, the statement was made that a well-publicized accident could be felt in traffic for two months thereafter. But some were not convinced, holding that revenue losses due to loss of public confidence cannot be proved statistically. Results of a questionnaire were presented which showed seasoned or persistent airline travelers putting faster aircraft as the outstanding technical improvement of the past years. However, "safety" was a significant write-in item in this questionnaire.

In illustrating why accidents come about, one

speaker commented that it was a chain formation of small errors rather than a single error, or error following upon error, that resulted in serious consequences. Item A, he said, may fail only once in 50,000 hr, item B in 100,000 hr, and item C in 20,000 hr. No single item may lead to a fatal accident, but the cumulative total of these failures may, and has, caused serious accidents. Attention, he said, must therefore be given to all the things that may go wrong, and each safety measure must be considered in the light of the whole.

Some of the measures now being worked out as laboratory projects to contribute to overall safety were listed by one speaker as: fire tests of installations, equipment, and materials; crash and deceleration tests of fuel tanks; tests of cockpit visibility; and development of instruments, accessories, and devices for analyzing structural and flight characteristics. The fruit of studies on cockpit visibility will be seen on aircraft now coming into service, it was revealed. Continuing tests are being conducted to improve the pilot's vision when flying through rain, while studies are being made of the effect of reflections in night flying.

The place of statistics in accident prevention came in for considerable discussion. Statistics are invaluable, it was pointed out, but the application of remedial measures cannot wait for statistics if public confidence is to be retained. There is such a thing as requiring too many statistics before acting, and another of acting before enough statistics are secured.

In this connection one speaker pointed out that there were not enough accidents (fortunately) to furnish the mass data needed for statistical analysis. The problem then becomes, he said, how to secure information on near misses. The several variables or sequences of events required to change an incident to an accident come together with sufficient frequency to cost the industry huge sums; therefore, no incident is too insignificant to receive attention.

By way of illustration, he pointed out that we know how many times pilots have flown into mountain tops, but we don't know how many near misses there have been. At the present time, the slips and fumbles, or potential accidents, are revealed by casual gossip alone and that is not good enough. There should be a place, he declared, where personnel can confess their errors without fear of ridicule or punishment, and without casting reflections on fellow workers.

That safety has been a real achievement was reflected in figures presented to show the growth of air transport since 1940. These are a 260% increase in number of aircraft in airline service, a 600% expansion in air lift, a 1100% increase in cargo ton-miles per hour, and a 875% increase in passenger-seat miles per hour.

Against this background of tangible performance the following forecast was made:

1. Substantial improvement in schedule regularity and dependability during the next five years from activation of the CAA-sponsored navigation improvement project presently emerging from the planning stage.
2. Basically, new transports introduced into service during the next 15 years will be powered by turbine powerplants (helicopters excepted).
3. Turbine-powered aircraft will be introduced into transport service in the United States within the next two years.
4. Commercial air strength will continue to increase through 1952 at a rate equal to or greater than any other commercial phase of national strength.

PRODUCTION

Advances to Speed Manufacture Of Military, Civilian Materiel

Based on discussions and eight papers presented at one Production session, one Engineering Materials session, one Body session, and one Aircraft session . . . "Advanced Production Developments," by **Joseph Geschelin**, Automotive Industries . . . "Increasing Productivity in Production Machining," by **Michael Field** and **Norman Zlatin**, Metcut Research Associates . . . "Mass Production Lapping Techniques," by **C. R. Moore**, Chevrolet Motor Division, GMC . . . "Developments in Large Closed Die Forging," by **E. O. Dixon**, Ladish Co. . . . "Mass Marquenching," by **W. B. Cheney** and **W. C. Hiatt**, International Harvester Co. . . . "Problems Involved in Joining Sheet Metal for Torque Converters," by **H. O. Flynn**, Chevrolet Motor Division, GMC . . . A Modern All-Aluminum Body Development for Production—Introduction: **E. C. DeSmet**, Willys-Overland Motors, Inc.; "Selection of Materials": **J. H. Dunn**, Aluminum Co. of America; "Spotwelding": **E. J. Zulinski**, Progressive Welder Co., and "Engineering, Fabrication and Assembly": **C. J. Schmidt**, Goodyear Aircraft Corp. . . . "German Aircraft Manufacturing Methods," by **August Bringewald**, Republic Aviation Corp. . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal, and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

MILITARY exigency plus normal incentives for more production and better products heightened interest in the new methods, machines, and material uses disclosed at the meeting. Exchanges on machining, brazing, lapping, heat-treating, forging, air assembly, and aluminum car body building presage economy in both civilian and military production.

Real gains are in the offing in machining time. Faster cutting rates and chip production, far exceeding conventional practice, are feasible, specialists in the field showed. Lab tests with cutting speeds up to 1200 fpm gave adequate tool life in machining certain steels. Contrast this with the 200 to 600 fpm speeds, current practice in machining cast irons and steels with carbide cutters.

Selecting the right material and developing its structure metallurgically holds the key to greater machining productivity. Milling and turning tests on cast iron proved that micro-structure rather than chemistry determines machinability. For example, annealing cast iron, to convert the matrix to ferritic form, has made possible cutting speeds five to ten times higher than those with conventional cast irons.

But to exploit high-speed cutting, close micro-structure control becomes a must. Coarse pearlitic iron gives twice the tool life of fine pearlitic iron. Even small quantities of free carbide drastically reduce tool life. Five percent free carbide in a pearlitic matrix reduces tool life one-third.

Tool material too must be compatible with micro-structure. Switch from high-speed steel to carbide tools can increase productivity five to 25 times, it was indicated. However, some drilling, broaching, and forming operations may require high-speed steel rather than carbide tools.

Brazing was said to be opening new vistas to fabrication of torque converters, important elements of automatic transmissions for both civilian and military vehicles. It has made possible a sheet steel-bladed converter for the Chevrolet Power Glide.

A converter assembled of stamped steel parts is more conducive to efficient large-scale production, particularly as compared with cast iron and cast aluminum units. The five elements making up the Chevrolet converter contain 257 pieces as brazed.

High production demands and close tolerance limits imposed by the Chevrolet converter job also brought about high production, automatic machine lapping methods. New equipment developed can generate relatively large flat surfaces to exceptionally fin tolerances.

Oil pump gear requirements give some notion of the needs to be satisfied. Such gears must be lapped to a tolerance of 0.0003 in. for thickness and 0.0001 in. for parallelism to assure an axial operating clearance of 0.0005 to 0.0007 in., with a minimum of selective assembly.

New lapping equipment used by Chevrolet is simple enough for an unskilled worker to operate and maintain. Ingenious fixture design, using Bakelite and micarta work holders, eliminates fixture clamping pressure, which distorts the part during the finishing operation.

Problems in fabricating aluminum car bodies have been licked, revealed reports on a four-company experimental car project. Interest ran high in the aluminum car body parts displayed at the meeting

ONE CORNER of the long registration desk which handled as high as 1500 registrations in one day during the meeting. (SAE Placement Committee Chairman Clifford M. Larson is the man on the right)

Another operation adapted to mass production is marquenching, a heat-treating process that involves the interrupted quench. It imparts a fine martensitic case structure. Marquenching produces gears with hardly any residual stresses, advised a production man who is using it. This increases durability from 100 to 200% and boosts load-carrying capacity 15 to 20%.

In addition, marquenching offers other advantages: elimination of quenching dies, plugs for splined bores, and individual handling of parts; greater alloy life; and increased productivity.

Typical of the savings from marquenching is the case of one transmission. It had 13 carburized parts, of which five were press quenched, five plug quenched, one individually quenched, and two batch quenched. Now these parts are all batch quenched, with tolerances and bearings within limits.

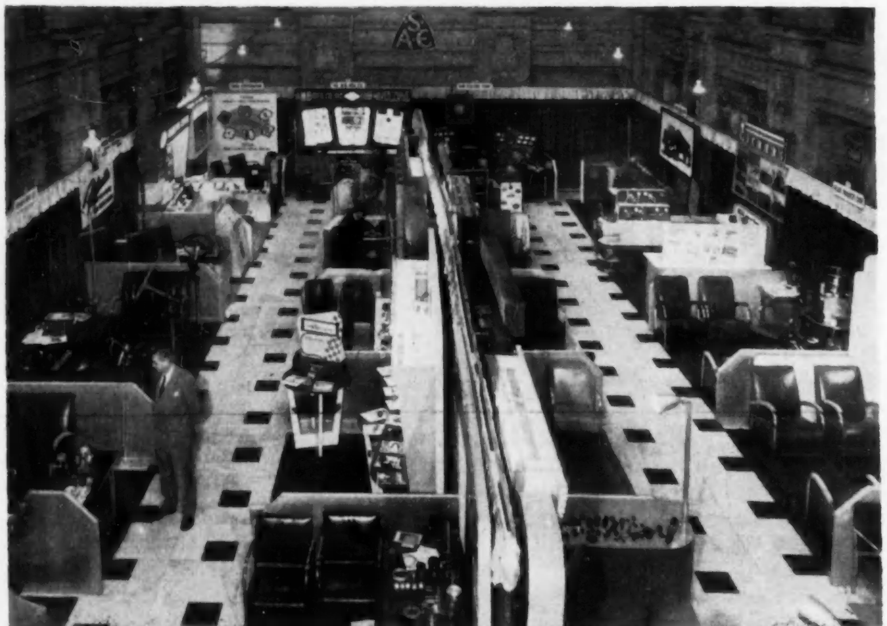
Bigger and sounder forgings are on the way using the closed die technique, predicted a forging specialist. This metal forming process not only yields superior engineering properties in a part, but also gives uniform quality and is economical in producing the final geometry. It's of particular import to the war-revitalized aircraft industry.

For example, an airplane landing-gear cylinder, extruded from a hinged end section, saved substantially in metal and machining. Complex multiple cylinder forging presses have been devised to produce plane propeller hubs with pierced barrels for blade sockets. Closed die forging can produce weldless rolled rings of complex contour. Typical of such products are rings gears up to several feet in diameter, cable sheave rims, and pipe and heat exchanger flanges.

On the physical properties side, closed die impact forgings have higher transverse ductility, as shown by elongation and area reduction in static tensile tests. Such forgings also are sounder since the process increases their density or specific gravity.

Engineers at the meeting concluded that closed

Automotive Products Display



48 Exhibitors

Aeroquip Corp.
Aluminum Co. of America
Aluminum Industries, Inc.
American Bosch Corp.
Auto Specialties Mfg. Co.
Bendix Aviation Corp.
Brush Development Co.
The Buda Co.
Campbell, Wyant & Cannon Foundry Co.
Cities Service Oil Co.
Cleveland Graphite Bronze Co.
Consolidated Engineering Corp.
Continental Motors Corp.
Cummins Engine Co.
DeLuxe Products Corp.
Detroit Gasket & Mfg. Co.
Dualoc Drive, Inc.
Elastic Stop Nut Corp. of America
Fram Corp.
The Garlock Packing Co.
Gemmer Mfg. Co.
General Plate Division, Metals & Controls Corp.
Hercules Motors Corp.
Koppers Co., Inc.

die forgings will give better and more dependable service. Increased size of individual forgings should make possible lighter designs, requiring less machining; elimination of connections, weld preparations, and machined fits, and should also do away with machining equipment, labor, processing time, and bulk of material inventory which these factors invoke.

A large capacity hammer developed by the Germans during the last war has been brought to this country. Now in operation, this machine can produce totally enclosed die contour forgings weighing more than 8000 lb. This German machine is only a starting point for continued development in the field, advised production specialists. Incidentally, the Russians also appropriated such a press.

Another German wartime development offered for consideration in aircraft assembly is the "hole production method." This airframe mass production system, developed by Dr. Spreiss of Dornier Aircraft, is said to reduce both operation time and production space and to save material. Crux of the method is to complete all the detailed airframe parts, including rivet holes, before assembly so that no large jigs and fixtures are necessary for assembly. Minor and major assemblies are fabricated on racks moved on conveyor lines.

There are at least five plus values from this assembly-without-fixtures method.

1. Assembly line equipment can be of simplest form.
2. There is no need for large, movable fixtures and jigs.
3. Considerable time and material are saved.
4. Little assembly or "tacking time" is required.
5. Working conditions are not disturbed by form jigs or mounting points common to large jigs.

Aluminum fabrication caught the eye of motor vehicle engineers too. Report on a four-company experimental project showed that aluminum alloy car bodies can be produced successfully in quantity. The higher material and processing costs for the

Big Attraction at Meeting

Showed Wares

Link Engineering Co.
Lisle Corp.
Lord Mfg. Co.
The MB Mfg. Co.
McQuay-Norris Mfg. Co.
Mechanics Universal Joint Division, Borg-Warner Corp.
Monroe Auto Equipment Co.
The Novi Equipment Co.
Physicists Research Co.
Ramsey Corp.
Redmond Co., Inc.
Sparks-Withington Co.
Spencer Thermostat Division, Metals & Controls Corp.
Spicer Mfg. Division, Dana Corp.
Stewart-Warner Corp.
Sun Electric Corp.
Tinnerman Products, Inc.
Titeflex, Inc.
Torrington Mfg. Co.
Vickers, Inc.
Victor Mfg. & Gasket Co.
Waldes-Kohinoor, Inc.
Waukesha Motor Co.
Zollner Machine Works

aluminum structure are compensated for by weight saving, performance improvement, and greater durability, said engineers who worked on the project.

An experimental coupe body of aluminum, including steel hardware, weighs 312 lb as against 600 lb for a similar all-steel body. The complete aluminum car's curb weight is 2406 lb while its all-steel counterpart would weigh 2700 lb—an 11% weight-saving. Using aluminum for chassis parts could save another 200 lb, these engineers estimated, boosting the total weight saving to 20%.

The lighter body has a lower center of gravity, which reduces side-sway and gives better roadability. Doors and the deck lid are much lighter and easier to handle. Aluminum also should prolong the vehicle's life. Its corrosive-resistant properties resist attack of the elements, abrasive attack of road dirt and pebbles, and alkaline reaction of chemicals on highways.

Time, materials, and equipment economies promised by these new developments whetted appetites for details of how-to-do-it disclosed at meeting sessions.

Pointed to as tools embodying new machining productivity ideas were two Kingsbury automatic drilling and tapping machines at Ford. They drill, ream, bore, spot face, and tap cast-iron water pump bodies. These machines have a central column with eight stations and are equipped with semi-automatic indexing. All tools are carbide, except the high-speed steel taps. Each machine combines the operations of four different machines—and also saves handling time, because of the carbide tools and high speeds used.

One of the stunts used in brazing torque converter elements is to suspend the 500-mesh copper brazing powder in a fluid vehicle. Two mixture ratios are used. The "heavy" mix having a viscosity of 15 sec calls for 5½ to 6 lb of copper per gal of fluid vehicle; the "light" mix with a viscosity of 13½ sec requires 4½ to 5 lb copper.

Vanes comprising the converter members are as-

sembled and held together by upsetting operations or several spot welds. The assemblies are then dipped into the brazing solution mixtures, which are in some cases brushed on. The assembly is then sent through a brazing furnace. After cooling, certain members are sized to correct slight out-of-roundness. Solidified copper collecting in the vane ends is removed by an abrasive wheel down to the true vane edge.

Another production "first" claimed for the Chevrolet automatic transmission is the Lapmaster. It produces a very flat surface with finishes to 25 to 35 micro-in. rms. This combination gives a good seal for all internal parts. Using a fine abrasive, it may be possible to eliminate all gaskets. Here is how the Lapmaster works:

Loose abrasive in a cutting fluid is fed to a large horizontally rotating lapping plate. Four conditioning rings in contact with the lap plate are restrained from rotating around the lap plate axis by bearings. But they do rotate around their own axis. The machine part to be lapped is loaded inside each conditioning ring. The Bakelite or micarta work holder, with holes shaped to the part, fits inside the conditioning ring. Thus the conditioning ring containing the parts rotates about its own axis while the lap plate covered with abrasive passes beneath it.

HUH? S. A. E. THAT AGAIN

The Society of Automotive Engineers announces that among the papers to be presented at its annual meeting in Detroit, Jan. 8-12, are:

"Engineering of involute splines."

"Mass marquenching."

"The irreversible adiabatic polytropic process with variable specific heat and its application to gas turbine cycle analyses."

From the Cleveland News

This planetary action makes the abrasive trace an infinite variation of paths across the work. The part shows no discernible pattern. With a fine enough abrasive no scratches can be seen, even under a magnifying glass.

Success of the other new mass production process disclosed, marquenching, advised a heat-treat specialist, lies in proper control of furnace temperature, carbon concentration, speed of quench, and quench time.

For example, at International Harvester furnaces are operated in cycle according to one of three specified case depths—0.025 to 0.035 in.; 0.031 to 0.047 in.; or 0.047 to 0.063 in.

Design of the 1600-gal quench tank was credited with making mass quenching feasible. The oil bath is held at 400 F, ± 2 F, by six radiant tubes which may heat or cool. The tank is designed so that oil flow is greatest at the submerged work level. The tank is located directly under the furnace side discharge door so that material discharged to the lowerator is into the 400 F oil. Work on the lowerator is automatically time quenched.

Design ingenuity also was pointed to in the huge German drop forging hammer, which has helped usher in an era of large-size closed die forgings. This machine avoids the most objectionable features found in large American-designed hammers since it has much greater capacity to withstand energy of blow. Thus the size of forgings can be larger.

This machine obviates the large inertia mass needed, in the form of an anvil block, by mounting the lower die in a movable ram which reciprocates counter to the upper ram and die. The two rams meet at the center of their combined travel with complete momentum conservation. The conventional way has been to transmit the blow's force through the forging to the stationary anvil block and foundation. Using this principle, the Germans produced a counter-blow hammer equivalent in forging performance to a conventional hammer rated at 100,000 lb.

There are problems extant with large closed-die forgings, a machine tool man quickly added to bring the technique's status into proper perspective. For example, forging billets weighing up to 12,000 lb are beyond the capacity of the usual billet-handling equipment in heavy drop-hammer shops. Larger controllable heating and cooling facilities than are available must be provided. Time-temperatures cycles, to which the material is subjected before forging, becomes more critical as cross-sectional dimensions increase. Bigger and better die blocks are needed. Success of closed-die forgings also calls for better lubrication of the metal die interface. Decarburization and carbon restoration too should be given serious consideration.

The other German warborn technique, the hole production method, held the attention of aircraft manufacturing men. Crux of the technique is a "master body," an aircraft component incorporating all the details, such as bulkheads, stringers, stiffeners, rigs, spars, and the entire rivet hole pattern, provided with drill bushings. The master body is of steel, electrically welded to avoid warping.

Tools needed for the method are developed from the master body. They are: templets for bulkhead and rib flanges; cutting fixtures for bulkhead and rib flanges; assembly and drill jigs for bulkheads and ribs; cutting and drill jogs for stringers and for skins.

Here is how the tools are made:

Thin sheet metal is stretched around the portion of master body from which the tool is desired. Stiffeners are welded to the tool. Rivet holes and cut-outs are determined from the master body. The tools then are removed from the master body and the drill bushings inserted into the rivet holes.

Other things new have been added to fabrication

f aluminum, demonstrated researchers on use of the material for car bodies. They showed how to lick forming, joining, and assembly problems in their project.

Aluminum forming in a die, they said, should permit the material to flow freely. The blank-holder pressure should be just enough to prevent wrinkles from starting. Compound curves are best formed by displacement of material rather than by stretching or drawing. For quantity production, aluminum body panels and parts can be manufactured in conventional iron or steel forming dies, similar to those used for steel panels. Die material should not be porous and should be polished, so as not to scratch the material while forming.

Most economical method of joining the aluminum body is resistance spotwelding. Areas inaccessible to the spotwelder were joined by riveting in the experimental aluminum car. Heat of torchwelding, it was felt, would reduce aluminum's strength.

In preparation for spotwelding, parts are cleaned by a degreasing bath, acid etch, hot water rinse, and air drying. Acid etch also prepares the surface for adhesion of paint primers. The welded and assembled body of the experimental car was given the usual body solder treatment at joints and surfaces needing attention. Primer coats of pyroxilin, zinc chromate or other quick-drying compositions are applied, after which finishing coats of enamel, synthetic enamel, or lacquer can be used.

Drastic Operating Conditions Confront Designers, Makers of AIRCRAFT

Based on discussions and seven papers presented at two Aircraft sessions and two Aircraft Powerplant sessions . . . "The Design and Development of the Lockheed Constitution," by **W. M. Hawkins** and **R. L. Thoren**, Lockheed Aircraft Corp. . . . "Investigations of Hydraulic Damping," by **J. E. Campbell**, North American Aviation Inc. . . . "Low-Temperature Lubrication of Aircraft Engines," by **Saul Barron**, Powerplant Laboratory, Air Materiel Command . . . "Starters for Turbojet Engines," by **W. D. Downs**, Powerplant Laboratory, Air Materiel Command . . . "High-Energy Multiple-Spark Ignition Systems for Jet Engines," by **M. A. Zipkin, H. E. Sheets,** and **C. N. Scott**, Goodyear Aircraft Corp. . . . "Turbojet and Turboprop Engine Controls," by **F. C. Mock**, Bendix Products Division, Bendix Aviation Corp. . . . "Working for Air Defense," by **Woldemar Voight**, Air Materiel Command . . . **These papers will appear in abridged or digest form in forthcoming issues of SAE Journal and those approved by Readers Committees will be published in full in SAE Quarterly Transactions.**

AIRPLANES are becoming larger and more complex. They are expected more and more to operate under cold-weather conditions, at high altitudes, and at higher speeds. Thus, some of the problems considered solved a few years ago are cropping up all over again.

The more drastic conditions have created new problems, too. The gas turbine, which sends planes at tremedous speeds and great altitudes, has generated questions not even dreamed of a few years ago.

Progress to date, as discussed at the aircraft and aircraft powerplant sessions, was reported as follows:

- Development of the large airplane presents special problems, due to its size, but these are not too difficult to overcome.
- Cold-weather operating troubles of large airplanes are being overcome.
- Starters of tremendous power are being developed for high-powered turbojet engines.
- Need for starting and operating turbojet engines at high altitudes has led to the development of a high-energy ignition system capable of initiating combustion up to a pressure altitude of 55,000 ft.
- Damping characteristics of the hydraulic booster systems used on high-speed aircraft have been analyzed.
- Advent of new higher-compression jet engines is changing fuel control requirements markedly.
- Military aircraft programs must keep production planning flexible and give high priority to research.

Large Aircraft Development

One problem in development of the Lockheed Constitution—admittedly an airplane of unusual size and complexity—was how to be sure that the hydraulic and electrical systems would function properly in flight. The expense and risk of flight testing this large airplane with relatively unproved components would be great.

So, according to Lockheed engineers, complete mockups of both systems were built for full-scale operational testing. These were arranged to permit production of failures or faults in order to determine the exact procedures and effectiveness of handling similar failures in flight. This high-cost program was felt to have been a sound investment. It eliminated many time-consuming delays during flight tests — and, it meant greater assurance of safety in these tests.

Because the control surfaces of this plane were so large—and no aerodynamic balance was contemplated—it was clear that a hydraulic boost system had to be used. To make such a system completely safe, three completely independent systems were installed. Actual flight testing showed that all four engines could be dead and sufficient power would be supplied by one wind-milling propeller to provide suitable control for landing. Revealed at the meeting also were results of an investigation of the damping properties of these hydraulic booster systems. The analysis was developed by converting the system into an equivalent electrical system. Voltage and current in the electrical circuit were related to pressure and flow rate, respectively, in the hydraulic system. Inertia, elasticity, and damping or resistance in the hydraulic system were

converted into the corresponding elements of inductance, capacitance, and resistance in the electrical system. The analysis was applied to the determination of hydraulic damping factors for various hydraulic system components, such as straight tubes, bends, fittings, and flexible hoses.

Lubrication oils have been developed for reciprocating engines that are satisfactory down to – 65 F, if diluted with gasoline, it was agreed by military men at the meeting. The lubrication system itself, however, was credited with causing engineers and the Air Force no end of trouble. Problems were said to include:

1. Oil dilution and segregation.
2. Engine breather difficulties.
3. Oil tank and engine vent icing.
4. Drainage of low points in the engine oil system.
5. Oil tank heat-transfer characteristics.

Satisfactory lubricants for turbojets also have been produced, it was indicated. But, especially with the dry sump engine, serious cold-weather difficulties seem not yet to have been overcome.

It was reported, however, that the application of the recently developed closed-circuit oil system to the jet engine may be the answer.

It was predicted that starters of 1000 hp may be used on turbojet engines of the near future. This power was compared with the 1000 hp that, less than 20 years ago, was the objective of aircraft-engine development itself, and with the 5-hp required for starting our largest reciprocating engine.

Basically, the reason for this disparity seems to be that the reciprocating engine requires starting assistance to only 2–3% of its rated speed, whereas the turbojet must be driven to 20% and more.

This high power requirement, along with the need for a self-contained starting system, were said to have led to the development of the cartridge starter and the air starter.

The cartridge starter has been most successful, according to reports, with a 3-sec burning interval.

The air turbine starter was considered to have the advantage for certain applications, especially for multi-engine aircraft.

The high-energy multiple-spark ignition system for jet engines was described as consisting essentially of an energy storage capacitator for each spark plug and a fast-acting, low-loss switch, which prevents the capacitators from discharging through the spark-plugs until a predetermined amount of energy has been stored in them.

Discharge takes place across the spark-plug gap in an interval of only 1 microsec.

The system was reported to have been developed to take care of the high ignition energy requirements of jet engines at pressure altitudes above 30,000 ft. Even under static conditions, it appears that about 75 times as much energy is needed to effect ignition at 75,000 ft than at 35,000. Under dynamic conditions, tests show that the difference becomes even greater.

Important features claimed for the new system include the following:

- It has no moving parts.
- It will fire fouled plugs.
- A shorted or otherwise damaged plug does not affect the operation of the other plugs.
- It can be made insensitive to large-input voltage fluctuations.
- It is relatively unaffected by long ignition leads.
- Because of the low repetition rate of this system, it can be operated with the same power input as conventional low-energy high-repetition rate systems.

Our gas turbine fuel control situation is in a rather bad state of confusion, according to some engineers. Matters are not being improved, either, by the development of the higher compression engines, it was indicated.

Many technical problems of power selection and transitional control remain to be solved, it was agreed. And there are the administrative problems, too. Among those mentioned at the meeting were:

1. Is the jet engine fuel control part of the engine or part of the airplane?
2. What are some of the special difficulties of the jet control engineer in meeting military needs?
3. Who should supervise the selection and adaptation of a fuel control system for a given jet engine and airplane?

Failure of the German aircraft industry to keep its production planning flexible and to continue research led to the collapse of German air defense and hastened defeat, according to a former Messerschmitt production executive at the meeting.

We can benefit from Germany's mistake in three ways, he said: keep aircraft production attuned to tactical needs; retain skilled technical personnel on industrial jobs rather than pressing them into military service; and continue a healthy research and development program, even during a hot war.

First blunder of the German high command, contended this man who was there, was failure to see itself forced from an offensive to a defensive war after the Battle of Britain. The urgent need to switch from bombers to fighters caught the industry flatfooted. Shortsighted planning made the change-over a slow, pathetic struggle, he said.

Crucial shortages of engineers and toolmakers, he reported, also impeded the conversion job. Policy level jobs were filled by politicians and "obedient officers," with no one capable of making clearcut technical decisions. Too late was the realization that research had been neglected.

Such mistakes must not be repeated in this country, aircraft men at the meeting agreed. This little-known story needs wider distribution, they said, if its moral is to do us any good: "Such things can't and mustn't happen here. . . and there is still time to do something about it."

Correction

Figs. 8 and 9 were transposed in the article "Fuel Needs of High Compression Engines," by M. M. Roensch and J. C. Hughes, p. 20 of the December, 1950, SAE Journal. Figure numbers and captions are correct as they are, but the charts themselves were transposed.

SAE National

Passenger Car, Body & Materials Meeting

Book-Cadillac Hotel, Detroit

March 6-8

TUESDAY, March 6

9:30 a.m.

H. E. CHURCHILL, Chairman

Development Highlights and Unique Features of the New Chrysler V-8 Engine
—W. E. DRINKARD and M. L. CARPENTIER, Chrysler Corp.
(Sponsored by Passenger Car Activity)

2:00 p.m.

W. P. EDDY, Chairman

Status of Ferrous Strategic Materials—Government and Industry Situation and Rulings
—E. C. SMITH, Republic Steel Corp.

Non-Ferrous Strategic Materials — Government and Industry Situation and Rulings
—R. J. LUND, Battelle Memorial Institute
(Sponsored by Engineering Materials Activity)

8:00 p.m.

R. A. TERRY, Chairman

Military Tactical Wheeled Vehicle Body Requirements.
—CAPT. J. L. QUINNELLY, Ordnance Department, Detroit Arsenal
(Sponsored by Body Activity)

WEDNESDAY, March 7

9:30 a.m.

E. J. HERGENROETHER, Chairman

A New Casting Method for Making Automotive Parts with Closer Tolerances
—E. E. ENSIGN and G. VENNERHOLM, Ford Motor Co.

Materials of Military Motorized Equipment
—COL. B. S. MESICK, Chief of Research and Materials Branch, Ordnance Dept.
(Sponsored by Engineering Materials Activity)

2:00 p.m.

V. M. EXNER, Chairman

Engineering Safety into Automobile Bodies
—H. K. GANDELOT, General Motors Corp.
(Sponsored by Body Activity)

8:00 p.m.

W. E. LYON, Chairman

Tire Symposium

Tire Noises
—W. F. PERKINS and W. F. BILLINGSLEY, B. F. Goodrich Co.

Safety and Ease of Car Handling
—J. J. ROBSON, Firestone Tire & Rubber Co.

Riding Comfort
—R. D. EVANS, Goodyear Tire & Rubber Co.

Tire Wear and Durability
—A. W. BULL, United States Rubber Co.
(Sponsored by Passenger Car Activity)

DINNER

6:30 p.m. March 8

L. I. WOOLSON
Chairman, SAE Detroit Section

Toastmaster, HARVEY CAMPBELL
Executive Vice-President,
Detroit Chamber of Commerce

DALE ROEDER
SAE President

Engineering and Management
HARRY J. KLINGLER
Vice-President, General Motors Corp.

THURSDAY, March 8

9:30 a.m.

J. B. MACAULEY, JR., Chairman

Instrumentation Symposium

Development of a Modern Dynamometer Laboratory
—C. L. BOUCHARD and HERBERT OXLEY, Ford Motor Co.

Some Developments in Dynamometer Equipment
—W. H. SMITH and J. B. BIDWELL, Research Laboratories Division, General Motors Corp.

A Study of Vehicle, Roadway, and Traffic Relationships by Means of Statistical Instruments
—T. J. CARMICHAEL, General Motors Proving Ground, and C. E. HALEY, Committee on Vehicle Characteristics, Highway Research Board

The Lashograph—An Instrument for Observing Valve Lash of a Running Engine
—EUGENE B. ETCHELLS, Chevrolet Motor Division, General Motors Corp.

Strain-Gage Method of Determining the Running Lash of L-Head and Overhead Engines
—A. E. CLEVELAND, Ford Motor Co.
(Sponsored by Passenger Car Activity)

2:00 p.m.

A. T. COLWELL, Chairman

Symposium—Improved Performance through Sound Valve Gear Design

Camshaft Design as Related to Valve Train Dynamics
—T. R. THOREN, H. H. ENGEMANN, and D. A. STODDART, Thompson Products, Inc.

Valve Lash, Automatic Tappets and Instrumentation
—VINCENT AYRES, Eaton Manufacturing Co.
(Sponsored by Passenger Car Activity)

Find Altitude Effect On Diesel Performance

Based on paper by

H. W. BARTH
D. M. LYON
and R. B. WALLIS

Electro-Motive Division,
General Motors Corp.

INCREASE in density altitude brings a decrease in power, but affects heat rejection only slightly. These results stem from tests made with the General Motors 567, 16-cyl, two-stroke diesel engine in the Model F7A locomotive, at altitudes of from 500 to 10,000 ft.

Middle curve of Fig. 1 shows how horsepower varied with change in density altitude. This curve represents total brake horsepower, and includes the power required for the various locomotive auxiliaries as well as the power available for tractive effort.

Power Drops Off

This curve shows practically no change in horsepower from sea level to 2500 ft. Between 2500 and 5000 ft, a decline in horsepower becomes evident. Above 5000 ft, the decline rate is about 20 hp per 1000 ft for this 16-cyl engine.

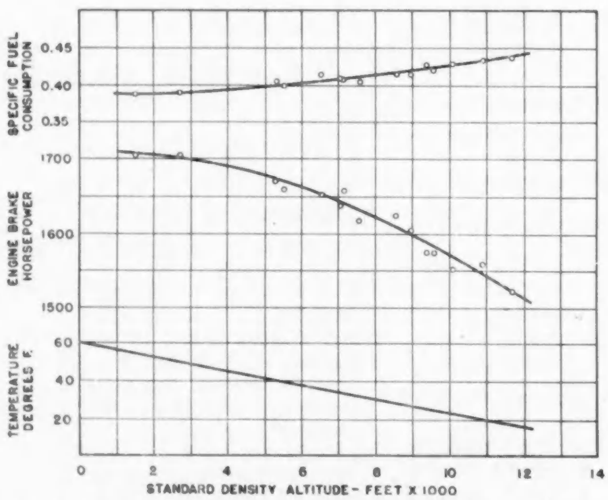


Fig. 1—Top curve shows how specific fuel consumption varied with density altitude in tests of the GMC Model 567 16-cyl, two-stroke diesel in a locomotive. The middle curve relates horsepower to density altitude. Lapse rate temperature, in bottom curve, equals 59 F (at sea level) less 3.566 F per 1000 ft elevation

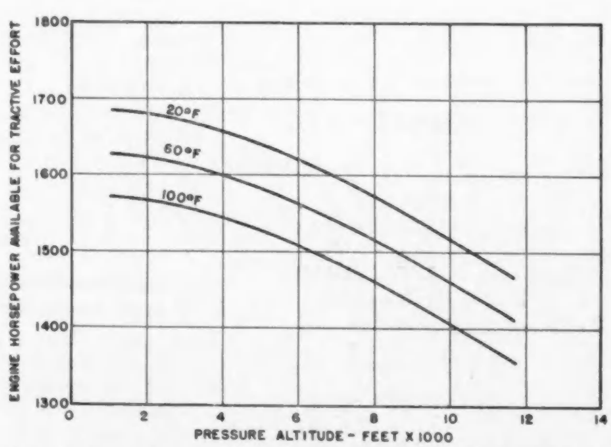


Fig. 2—From this chart can be determined the horsepower the engine will deliver under given temperature and altitude conditions

Of course, additional fuel would give more horsepower at any elevation. But this additional horsepower is not proportionate to the additional fuel supplied.

Top curve in Fig. 1 represents specific fuel consumption in relation to density altitude. Specific fuel consumption is a function of brake horsepower output. Since weight of fuel injected in pounds per hour remains constant for a given throttle position, change in specific fuel consumption is inversely proportionate to change in horsepower.

Standard density altitudes were based on standard elevation pressures and a uniform temperature lapse rate of 59 F for sea level minus 3.566 F for each 1000 ft in elevation. Where pressure altitude is accompanied by a temperature equal to the lapse rate temperature, the pressure and density altitudes are equal. The bottom curve in Fig. 1 shows this lapse rate temperature.

Fig. 2 consists of three curves showing engine crankshaft horsepower available for tractive effort as related to pressure altitude. These curves show horsepower which was available in the test locomotive and should be adjusted to rated horsepower for applications to other locomotives.

Estimating Power

These curves are for constant temperature and are parallel to each other. Thus the expected horsepower for a locomotive under any particular pressure altitude and temperature conditions may be determined.

The tests also revealed that heat rejection in the exhaust gases remained nearly constant at all altitudes. This was accompanied with an increase in average exhaust temperature from 800 F at sea level to 1000 F at the maximum altitude.

In this particular engine, exhaust heat rejection amounted to about 70,000 Btu per min. Heat rejection to the cooling water increased slightly between the low and high altitude extremes, as did heat rejection to the lubricating oil.

How Efficiency Suffers

Heat energy converted to work was 73,000 Btu per min at La Grange, Ill. (lowest test site) as against only 65,000 Btu per min at Tennessee Pass (highest test site). This is a drop in thermal efficiency from 33 to 29.4%. (Paper "Altitude Performance of the Electro-Motive 567 Engine under Railroad Conditions," was presented at SAE National Diesel Engine Meeting, Chicago, Nov. 3, 1950. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Cub Tractor Engine Tests Fuels and Oils

Based on paper by

W. F. FORD and O. L. SPILMAN

Continental Oil Co.

THE engine powering the Farmall Cub tractor has proved to be a valuable test tool for laboratory evaluation of fuels and oils. It satisfies test engine design requirements and accurately predicts fuel or oil performance in full-scale engines.

The Cub engine fulfills our needs for a small engine suitable for laboratory testing, which are:

1. Multicylinder.
2. Closely parallels automotive engine design.
3. Has hardened crankshaft for use with copper-lead connecting rod bearings.
4. Has full pressure lubrication system.
5. Ruggedly constructed to permit extended periods of over-loaded and hot operation.
6. Being in commercial production in considerable quantity makes for economical initial cost and easy replacement parts procurement.

The engine is of satisfactory size. It is small enough to use small quantities of fuel and oil for test. Yet its unit loadings and clearances compare to a full-scale engine within the Cub's normal operating range.

Cub engine test results correlate well with accepted full-scale gasoline engine tests.

For example, Fig. 1 shows comparative test data for oils ranging from

Continued on Page 107

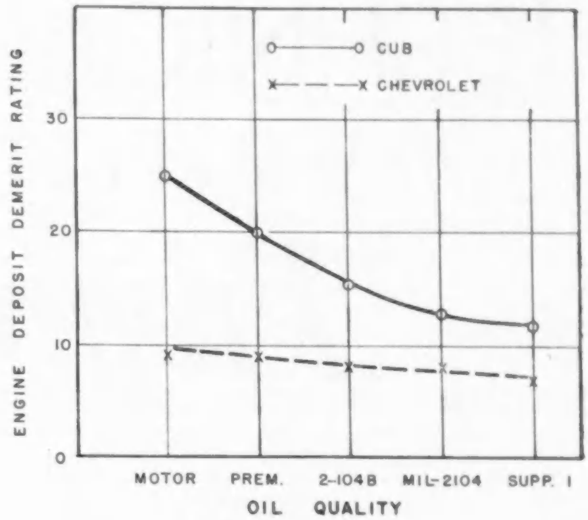


Fig. 1—Comparison of deposit level of Chevrolet L-4 and Cub engine tests

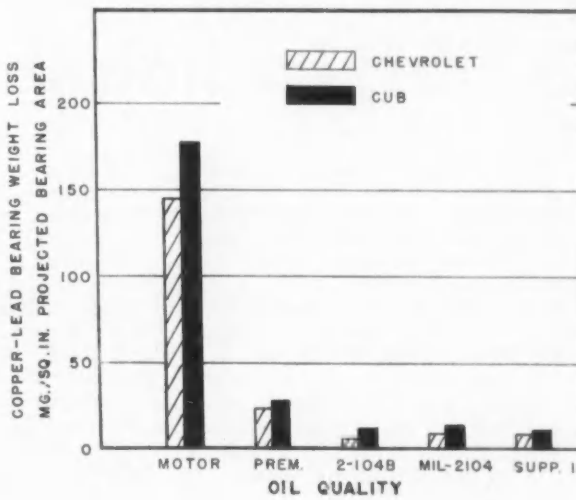


Fig. 2—Bearing losses in the Chevrolet L-4 and Cug engine tests compared quite well

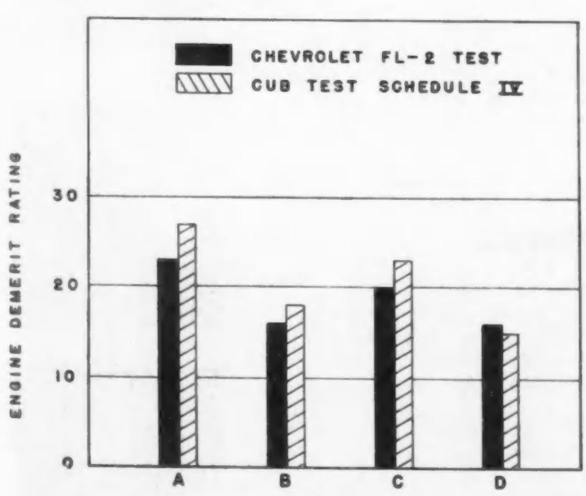


Fig. 3—Engine deposit ratings in both the Chevrolet and Cub FL-2 tests agreed closely

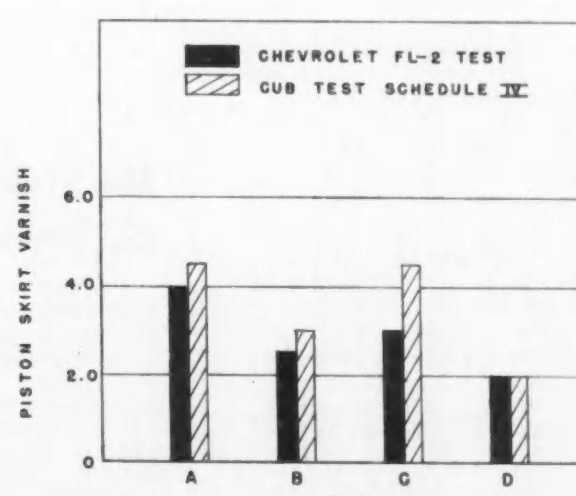


Fig. 4—Cub test results on piston skirt varnish correlated well with those from Chevrolet FL-2 tests

TECHNICAL COMMITTEE *Progress*

Sparrow

Kelly

Lewis

Lundquist

Nuttila

Tanquary

Sparrow Is Named Chief Of '51 Technical Board

S. W. SPARROW has been named chairman of the SAE Technical Board for 1951. Vice-president of engineering for Studebaker Corp., Sparrow is a Past-President of SAE and has served on the Technical Board as well as SAE technical and administrative committees. He succeeds retiring Board Chairman W. H. Graves.

SAE Technical Board

S. W. Sparrow, Chairman

B. B. Bachman
Harry Bernard
G. W. Brady
A. T. Colwell
G. A. Delaney
C. T. Doman
L. A. Gilmer
A. G. Herreshoff
R. D. Kelly
R. P. Kroon
R. P. Lansing
R. P. Lewis
W. G. Lundquist
M. E. Nuttila
R. J. S. Pigott
H. L. Rittenhouse
E. W. Tanquary
R. R. Teetor
H. T. Youngren

Also appointed by the SAE President were five new members to start three-year terms in 1951. The new appointees are: R. D. Kelly, United Air Lines, Inc.; R. P. Lewis, Spicer Manufacturing Division, Dana Corp.; W. G. Lundquist, Wright Aeronautical Corp.; M. E. Nuttila, Cities Service Oil Co.; and E. W. Tanquary, International Harvester Co.

Board members whose terms expired at the end of 1950 are: Charles Froesch, Eastern Air Lines Inc.; C. E. Frudden, Allis-Chalmers Mfg. Co.; Arthur Nutt, consulting engineer; W. D. Reese, International Harvester Co.; R. L. Weider, White Motor Co.; and D. K. Wilson, New York Power & Light Corp.

SAE Standards In ICC Revision Proposals

FOURTEEN SAE Standards and Recommended Practices are referenced in proposed revisions of the Motor Carrier Safety Regulations currently under consideration by the Interstate Commerce Committee.

Equipment meeting these standards would be deemed by the ICC to be in compliance with the regulations.

Copies of these 14 Standards and Recommended Practices—comprising 32 pages reprinted from the 1950 SAE Handbook—are available to SAE members for $1 and to nonmembers for $2

om the SAE Special Publications Department.

The items referred to are:

1. SAE Standards for Electric Headlamps for Motor Vehicles.
2. SAE Recommended Practice on Sealed Beam Headlamp Units for Motor Vehicles.
3. SAE Recommended Practice for Clearance, Side-Marker, and Identification Lamps.
4. SAE Standard for Tail Lamps.
5. SAE Standard for Color Specification for Electric Lamps.
6. SAE Standard for Stop Lamps.
7. SAE Recommended Practice for Reflex Reflectors.
8. SAE Standard for Insulated Cable.
9. SAE Recommended Practice for Automobile Wiring.
10. SAE Standard for Cable Terminals.
11. SAE Standard for Hydraulic Brake Hose, Air Brake Hose, or Vacuum Brake Hose.
12. SAE Recommended Practice for Electric Emergency Lanterns.
13. SAE Recommended Practice for Passenger Car Trailer Couplings.
14. American Standard Safety Code for Safety Glass for Glazing Motor Vehicles Operating on Land Highways.

AMS Up For Revision

THE following proposed-revised Specifications are being circulated to industry for comment and criticism by the SAE Aeronautical Materials Specifications Division:

- AMS 2400J, Cadmium Plating
- AMS 2407A, Chromium Plating, Porous
- AMS 2800A, Identification, Finished parts
- AMS 4840A, Leaded Bronze Castings, 70Cu—24.5Pb—5.5Sn
- AMS 4842A, Leaded Bronze Castings, 80Cu—10Sn—10Pb
- AMS 4845D, Bronze Castings, 88Cu—10Sn—2Zn
- AMS 4846A, Bronze Castings, 89Cu—11Sn—2Zn
- AMS 4855B, Bronze Castings, 85Cu—5Sn—5Pb—5Zn
- AMS 4860A, Manganese Bronze Castings, 57.5Cu — 40Zn — 1.2Fe — 1.0Al — 0.3Mn
- AMS 4862B, Manganese Bronze Castings, 64Cu — 24Zn — 5.2Al — 3.8Mn — 3.0Fe
- AMS 4870A, Aluminum Bronze Castings, Centrifugal and Chill 85Cu — 11.2Al—3.8Fe, As Cast
- AMS 4871B, Aluminum Bronze Castings, Centrifugal and Chill 85.3Cu — 10.9Al—3.8Fe, Heat Treated
- AMS 4872A, Aluminum Bronze Castings, Sand, 85Cu — 11.2Al — 3.8Fe, As Cast
- AMS 4873A, Aluminum Bronze Castings, Sand, 85.3Cu—10.9Al—3.8Fe, Heat Treated
- AMS 5024C, Steel, Free Cutting, (0.32-0.39C) (SAE 1137)
- AMS 5310B, Iron Castings, Plarlitic Malleable
- AMS 5351A, Steel Castings, Sand, Corrosion Resistant, 12.5Cr
- AMS 5354A, Steel Castings, Precision Investment, Corrosion Resistant 13Cr —3W—2Ni
- AMS 5360A, Steel Castings, Precision Investment, Corrosion and Heat Resistant, 17Cr—13Ni—2Mo
- AMS 5365A, Steel Castings, Sand, Corrosion and Heat Resistant, 25Cr—20Ni
- AMS 5366A, Steel Castings, Precision Investment, Corrosion and Heat Resistant, 25Cr—20Ni
- AMS 5373A, Alloy Castings, Sand, Corrosion and Heat Resistant Cobalt Base—28Cr—5W
- AMS 5375A, Alloy Castings, Precision Investment, Corrosion and Heat Resistant, Cobalt Base—25Cr—5W
- AMS 5378A, Alloy Castings, Precision Investment, Corrosion and Heat Resistant, Cobalt Base — 25Cr — 32Ni — 5Mo
- AMS 5380A, Alloy Castings, Precision Investment, Corrosion and Heat Resistant, Cobalt Base—25Cr—15Ni—6Mo
- AMS 5382B, Alloy Castings, Precision Investment, Corrosion and Heat Resistant, Cobalt Base — 25.5Cr — 10.5Ni —7.5W
- AMS 5389A, Alloy Castings, Sand, Corrosion and Heat Resistant Nickel Base—17Mo—15Cr—6Fe—5W
- AMS 5392C, Alloy Iron Castings, Sand, Corrosion Resistant, 15Ni—6Cu —2Cr

Journal Index Available

A complete Index covering the twelve 1950 issues (Vol. 58) of the SAE Journal is now available to members and subscribers free upon request.

You'll be interested to know . . . .

GENERAL CHAIRMEN FOR THREE NATIONAL MEETINGS were named by the Council last month. M. G. BEARD, American Airlines, Inc., will be general chairman of the Spring National Aeronautic Meeting in New York; S. C. HETH, J. I. Case Co., of the National Tractor Meeting in Milwaukee; and F. W. FINK, Consolidated Vultee Aircraft Corp., of the Fall National Aeronautic Meeting in Los Angeles.

FOR THE NATIONAL TRACTOR MEETING, there will be three subcommittees working under General Chairman Heth, and Vice-President R. C. Williams. Tractor Vice-Chairman for meetings: H. L. BROCK will himself act as chairman of the Tractor & Farm Machinery Subcommittee. TREVOR DAVIDSON will chairman the Construction & Industrial Machinery Subcommittee; and D. C. HEITSHU will head the Implement Subcommittee. Brock is of Ford Motor Co.; Davidson of Bucyrus-Erie Co.; and Heitshu, of John Deere Harvester Works.

ROBERT F. BLACK, president, White Motor Co., has accepted the chairmanship of the 1951 SAE Beecroft Memorial Lecture on Traffic Safety. The Committee this year will name the fifth Beecroft Lecturer, chosen "for meritorious contributions to traffic safety." The Lecture series, resulting from a bequest to SAE in the will of SAE Past-President David Beecroft, provides for a total of ten awards in ten successive years.

ERNEST P. LAMB, chief engineer of Chrysler Corp.'s Truck Division, has been named by the Executive Committee of the SAE Technical Board to represent SAE on the National Committee on Uniform Traffic Laws and Ordinances. His alternate is V. J. Roper of General Electric Co.

ROBERT H. DAISLEY, vice-president and director of manufacturing of Eaton Mfg. Co., Cleveland, is the new president of Automotive & Aviation Parts Manufacturing association.

About

FOSTER N. PERRY has been elected executive vice-president of the American Bosch Corp., Springfield, Mass. Perry has been vice-president of the corporation for the past ten years, during which period he has been in charge of manufacturing sales.

S. W. ROLPH, president, announces that The Electric Storage Battery Co., Philadelphia, Pa., has established a new wholly owned company to carry on the foreign business of Electric Storage Battery and its subsidiaries. Rolph will be head of the newly organized firm.

CARL T. HILTERMANN is now a laboratory technician engaged in investigation and test of experimental and production units for the Saval Division of William R. Whittaker Co., Ltd., Los Angeles. His previous position was engineer with Hoof Products Co. in Chicago.

LEWIS C. KIBBEE, assistant chief, Equipment and Operations Section, American Trucking Associations, Inc., Washington, D. C., was recently elected national treasurer of the National Speleological Society. He also has been active in the Washington Grotto of the Society.

RAYMOND W. YOUNG was appointed vice-president in charge of engineering and recommended for membership on the board of directors of Reaction Motors, Inc., Rockaway, N. J. Young was formerly vice-president of engineering of the Wright Aeronautical Corp. He has served as chairman of the Panel on Aircraft Propulsive Systems, Committee on Aeronautics, Research and Development Board in Washington, and as Special Consultant to the U. S. Air Forces, and to the NEPA Project at Oak Ridge. Young served as SAE vice-president representing Aircraft Powerplant Activity in 1945, and was also a member of the SAE Technical Board that same year.

General Motors Promotions

Skinner

Lenz

Wolfram

Metzel

Mathews

Promotions of SAE members in General Motors Corp. and its Divisions, in addition to those announced on page 76 of SAE Journal's January issue, include the following:

SHERROD E. SKINNER, vice-president of General Motors and Oldsmobile general manager since 1940, is now group executive in charge of GMC accessories divisions and a director of the Corporation. **ARNOLD LENZ** is now vice-president of GMC, and general manager of Pontiac Division. **JACK F. WOLFRAM**, chief engineer of Oldsmobile since 1944, became Skinner's successor as general manager of Oldsmobile. **HAROLD N. METZEL**, Wolfram's former assistant chief engineer, becomes Oldsmobile's chief engineer. He has been with Oldsmobile since 1928. **VERNER P. MATHEWS** has been appointed chief engineer of Buick Motor Division. Mathews had been chief engineer of GMC's Moraine Products Division.

Members

WILLIAM P. LEAR has been named the recipient of the 1950 Robert J. Collier Trophy symbolizing, ". . . the greatest achievement in aviation in America during the previous year," by the National Aeronautic Association in Washington, D. C. Lear, chairman of the board of directors and director of research and development of Lear, Inc., Grand Rapids, Mich., received the award from the President of the United States on December 15 ". . . for his outstanding achievement in the development, perfection, application, and production of the Lear F-5 Automatic Pilot and Automatic Approach Control Coupler System, which makes possible the safe landing of jet aircraft regardless of extreme weather or visibility conditions."

P. W. J. ROSS, formerly assistant manager of the Weatherhead Co., Canada, St. Thomas, Ont., now holds a similar position with Robin Hood Flour Mills, Ltd., Humberstone, Ont.

EMIL O. WIRTH was recently appointed plant manager of the Direct Fuel Injection Pump Division of Bendix Products of South Bend, Indiana Division of Bendix Aviation Corp. He had been Staff assistant for the Bendix Products Division.

KACHAS DERDIARIAN, formerly employed as assistant standards supervisor with Pan American Airways, New York, is now standards analyst "A" at Lockheed Aircraft Corp., Burbank, Calif.

JOAQUIN A. SAAVEDRA is attending Purdue University under the Air Force Officer Education Program. This program is administered by The USAF Institute of Technology, Wright Patterson Air Force Base, Dayton, Ohio. He attends the Aeronautical Engineering Graduate School, majoring in Jet Propulsion. Saavedra was previously employed as a research and development engineer.

CARL H. SCHEUERMAN is now a sales engineer with the Denison Engineering Co., Columbus, Ohio. Prior to this he was project engineer at Borg-Warner Corp. in the engineering development section, Bellwood, Ill.

ROBERT S. SEARS, who had been a salesman for Howard Cooper Corp. and Mack Truck Co., is now serving in the same capacity with Baer Steel Products Co., Auburn, Wash.

CHARLES A. PEEK, JR., who was a laboratory instructor at Yale University, is a junior engineer—research and development—for Carrier Corp., Syracuse, N. Y. His new position involves consulting on all phases pertaining to development of company products, as assistant to the chief engineer.

L. I. WOOLSON has been elected vice-president of manufacturing and a director of DeSoto Division, Chrysler Corp., Detroit. Woolson joined Chrysler in 1928 and has been with DeSoto since 1936. He is chairman of the SAE Detroit Section.

C. G. A. ROSEN, former director of research and now consulting engineer at Caterpillar Tractor Co., Peoria, Ill., presented a review of diesel engine development at the Research Laboratory of Caterpillar as the James Clayton Lecture at the General Meeting of the Automobile Division, Institution of Mechanical Engineers in London on November 14. He repeated the lecture at Birmingham, Glasgow and Manchester. Rosen is the sixth man awarded this annual honor, and only the second American.

WALTER E. THILL has been advanced to assistant chief engineer of Federal-Mogul Corp., Detroit. For the present, he will direct engineering activities connected with the Federal-Mogul Service Division.

J. P. CHARLES has been promoted to assistant chief engineer of Pontiac Motor Division, GMC, Pontiac, Mich. Charles has been with Pontiac since 1928, when he began as a road test engineer. He was placed in charge of the dynamometer laboratory in 1932 and in 1945 was made superintendent of experimental engineering.

CHARLES J. WILHITE, who started with Cummins Engine Co., Inc., Columbus, Ind., in 1939, has been promoted to acting northwest regional manager of Cummins. Prior to this, he had been northwest regional service representative.

ALBRECHT GOERTZ, industrial (products) designer has established his own studios for professional activity in New York City. He has been in his native Germany recently working with European manufacturers on streamlining their products for the American market.

M. J. TAUP, formerly district manager of Vickers Inc., Chicago, has recently been appointed Mobile Products sales manager in Detroit. He has been engaged in engineering and sales with Vickers for 15 years.

HARVEY F. BERGHAUS has become president of Transport Products Co. in Cleveland. He was formerly vice-president in charge of sales and engineering for American Coach and Body Co.

COL. CHARLES E. BATSTONE has resigned his position as sales engineer for Brockway Motor Co., Inc., to become chief of the Industrial Branch, Security Division of the U. S. Air Force in Washington, D. C.

FRANK W. TELFORD, manager of The Goodyear Tire & Rubber Co.'s Detroit Manufacturers' Sales office, was presented with a 40-year service pin, marking his four-decade association with the company. As a memento of his fortieth anniversary, his Manufacturers' Sales Department associates gave him a solid silver cigar chest atop which is a replica of the 40-year service pin he received.

New officers for the Institute of the Aeronautical Sciences for 1951 are as follows: **RAYMOND D. KELLY**, superintendent of Technical Development, United Air Lines, Inc., vice-president; **WILLIAM T. SCHWENDLER**, executive vice-president and director, Grumman Aircraft Engineering Corp., vice-president; **EDWARD C. WELLS**, vice-president of engineering, Boeing Airplane Co., vice-president; **E. E. ALDRIN**, aviation manager, Atlas Supply Co., treasurer; **S. PAUL JOHNSTON** has been reelected as director.

WILLIS McGERALD PEIRCE, assistant to the general manager of the technical department of the New Jersey Zinc Co., Palmerton, Pa., has been elected 1951 president of the American Institute of Mining and Metallurgical Engineers, and will take office on Feb. 20, at the Institute's annual meeting in St. Louis.

H. O. MOELLER is now connected with Key System Transit Lines, Oakland, Calif., as general superintendent of automotive equipment. Prior to this, for 26 years he was associated with Mack Trucks, Inc., with headquarters out of Chicago as division service manager in charge of service in the central and southwestern states. He left Mack in January, 1947, and became connected with Key System Transit Lines as director of purchases and stores during the reorganization of the property, and a few months later became general superintendent of automotive equipment when the conversion from street cars to buses became effective.

CARL G. SEASHORE has joined the staff of the Dan Dugan Oil Transport Co.; associate in charge of Motor Fleet Safety Foundation of Penn State College Institute of Public Safety, Seashore is taking a year's leave of absence from that position. For the past five years Seashore has headed and developed an educational motor fleet management program, presented with cooperation of colleges and universities in 38 states.

WILLIAM J. SKELLEY, formerly a layout draftsman with Bendix Products Division of Bendix Aviation Corp., South Bend, Ind., is now design draftsman with Bell Aircraft Corp., Buffalo, N. Y.

F. X. McCORMACK is now administrative assistant to the sales director of the Alexander Summer Co., Teaneck, N. J. Prior to this, he was service engineer with Wright Aeronautical Corp., Wood Ridge, N. J.

Obituaries

CARL E. HEUSSNER

Carl E. Heussner died of a heart attack on Jan. 2 at Doctors Memorial Hospital in Detroit. He was 51 years old.

An authority on electroplating, he was the Chrysler Corp. engineer responsible for solving the nickel shortage in connection with the atomic bomb project in World War II. Heussner had been with Chrysler for the last 22 years, and was director of the materials testing laboratories. He developed many new methods of electroplating as well as new techniques for testing them.

FRANK B. SEXTON

Frank B. Sexton passed away. He was 68 years old.

Born in Aurora, S. D., he later moved west to Tacoma, Wash., where he completed grammar and high schools. He graduated from the University of Washington in 1900, and joined the old Union Iron Works as assistant to the chief engineer. Later, in 1914, he joined the P. A. Rockefeller interests in New York City, becoming chief executive officer of the Van Blerck Motor Co., Monroe, Mich. In 1921 he left the Rockefeller interests and organized the Sexton Engineering Co., specializing in the design of internal combustion engines. This company was active until 1934, at which time Sexton joined the Electric Auto-Lite Co., Toledo, Ohio as manager of their Marine Division. He left Auto-Lite in 1937 and became a resident of Glendale, Calif.

Sexton had been an active member of SAE since 1917, and served on many standardization and other committees. He was also a member of long standing of the Society of Naval Architects and Marine Engineers, and he also held a U. S. Chief Engineer's license for unlimited tonnage.

Students Enter Industry

DON J. CRITTON (University of Wisconsin '50) to West Bend Aluminum Co., Hartford Division, Hartford, Wis.

RONALD D. RAMSEY (Purdue University '50) to Motor Truck Division, International Harvester Co., Fort Wayne, Ind.

ROBERT J. OVERLY (Texas A & M '50) to The Western Co., Snyder, Texas.

MORRIS FRANKLIN THOMPSON (Ohio State University '50) to Alden E. Stilson & Associates, Columbus, Ohio.

JAMES J. HANSEN (University of Idaho '50) to Idaho Power Co., Boise, Idaho.

RALPH N. STOLTZ (Oregon State College '50) to Salem Equipment and Supply Co., Salem, Ore.

FRANCIS JOSEPH SHINALY (The Pennsylvania State College '50) to Frankford Arsenal, Philadelphia.

KENNETH SECUNDA (Wayne University '50) to Paramount Engineering Co., Detroit.

FRANCIS B. HYLAND (University of Massachusetts '50) to Factory Insurance Association, Hartford, Conn.

LEONARD E. BUYER (Cornell University '50) to Carborundum Co., Globar Division, Niagara Falls, N. Y.

EUGENE W. TRAPP (Lawrence Institute of Technology '50) to Detroit Tank Arsenal, Centerline, Mich.

RICHARD T. VANDERPOOL (University of Wisconsin '50) to King Motors, Inc., Madison, Wis.

DONALD L. JACOBS (State University of Iowa '50) to Solar Aircraft Co., Des Moines, Iowa.

FRED WILLIAM ABERLE (Northrop Aeronautical Institute '50) to North American Aviation Inc., Los Angeles, Calif.

LEIGH J. ABELL (University of California '50) to Ford Motor Co., Richmond, Calif.

LOUIS BALDASSIN (Academy of Aeronautics '50) to Boeing Airplane Co., Wichita, Kans.

HAROLD CLARENCE BAKER (Purdue University '50) to Bendix Aviation Corp., South Bend, Ind.

JOHN R. STEPHENS (Southern Methodist University '50) to Ford Motor Co., Dallas.

CLARENCE E. STOCKS (University of Illinois '50) to C. S. Johnson Co., Champaign, Ill.

WILLIAM JAMES TOMLINSON (Detroit Institute of Technology '50) to Motor Products Corp., Windsor, Ontario.

DONALD EDWARD WERTZ (Purdue University '50) to Columbia Machinery & Engineering Corp., Hamilton, Ohio.

FRANK WILLARD ZURN (Cornell University '50) to J. A. Zurn Mfg. Co. & Subsidiary, American Flexible Coupling Co., Erie, Pa.

PHILIP M. ROGERS (University of Detroit '50) to Holley Carburetor Co., Detroit.

JOSEPH KAINER, JR., (Bradley University '50) to Boeing Airplane Co., Seattle, Wash.

HENRY FRAZER GURLEY, JR., (University of Virginia '50) to Acme Visable Records, Crozet, Va.

WILLIAM F. GILMAN (Cal-Aero Technological Institute '50) to Lockheed Aircraft Co., Burbank, Calif.

ANDREW ACAMPORA (California State Polytechnic Institute '50) to Douglas Aircraft Co., Inc., El Segundo, Calif.

EDMUND JOSEPH WAYNE (Lawrence Institute of Technology '50) to Thompson Products, Inc., Detroit.

PHILIP T. HEUSTON (University of Colorado '50) to Westinghouse Electric Co.'s Elevator Division, Denver, Colo.

RALPH GONZALES, JR., (Purdue University '50) to Lockheed Aircraft Corp., Burbank, Calif.

KENNETH S. PALMER (Chrysler Institute of Engineering '50) to Chrysler Corp., Detroit.

GASTON L. RAFFAELLI (City College of New York '50) to Midwest Piping & Supply Co., New York City.

CHRISTIAN J. RAHNKE (Wayne University '50) to Westinghouse Electric Corp., East Pittsburgh, Pa.

WILLIAM OLE SATHER (Michigan State College '50) to Detroit Arsenal, Centerline, Mich.

KEITH L. HESTER (University of Southern California '50) to Commercial Casting Co., Los Angeles.

Students Enter Service

JOHN E. KEANE (Manhattan College) to U. S. Naval Reserve (recalled to active duty with U.S.N.R.).

GEORGE J. HOLUBASCH (Parks College) to U. S. Navy.

CHARLES H. HARVEY (University of Colorado '50) to U. S. Army, Ft. Riley, Kan.

CURTIS L. WALKER (University of Oklahoma '50) to U. S. Air Force, Wright-Patterson Air Force Base, Dayton, Ohio.

ADOLPH J. GAWIN (University of Illinois '50) to U. S. Army Corps of Engineers, Chicago, Ill.

FRANK BERNARD DESIO (Bradley University '50) to U. S. Air Force, Tucson, Ariz.

JOSEPH P. WINTERHALTER (Purdue University '50) to U. S. Army.

EUGENE N. BORSON (University of California '50) to U. S. Air Force, Chandler, Ariz.

FRANCIS E. BIGOS (University of Colorado '50) to U. S. Air Force, Lowry Air Force Base, Denver, Colo.

IVEN C. KINCHELOG, JR., (Purdue University '49) to U. S. Air Force, O'Hare International Airport, Park Ridge, Ill.

JACK K. GILBERT (Oklahoma A & M College '50) to U. S. Army, St. Louis, Mo.

ROBERT E. HARRIS, JR., (University of Notre Dame '50) to U. S. Army, Ft. Monmouth, N. J.

CALENDAR

British Columbia—Feb. 15

Hotel Georgia, Vancouver, B. C.; dinner 6:30 p.m. Meeting conducted by Student Group from University of British Columbia.

Cincinnati—Feb. 26

Engineering Society Headquarters; dinner 6:30 p.m. Meeting 8:00 p.m. Speaker to be announced. Refreshments after meeting.

Cleveland—Feb. 12

Hotel Tudor Arms, Cleveland; dinner 6:30 p.m. Torsional Vibrations— E. R. Brater, assistant chief engineer, Cleveland Diesel Engine Division, GMC.

Mohawk-Hudson Group—Feb. 14

Union College, Schenectady; dinner 6:30 p.m. Meeting 8:00 p.m. Weather Control by Cloud Seeding—D. B. Vonnegut, Research Laboratories, General Electric Co.

New England—March 6

Graduate House, M.I.T., Cambridge; dinner 6:30 p.m. Meeting 7:30 p.m. Topic: Automotive Transmission. Speaker provided by Chevrolet Motor Division, GMC.

Northern California—Feb. 10

Salem Room, Claremont Hotel, Berkeley; dinner 8:00 p.m. Annual Dinner Dance.

Philadelphia—Feb. 14

Engineer's Club, Philadelphia; dinner 6:30 p.m. Meeting 7:45 p.m. What Axle Loads Should Highways Handle? —A. B. Gorman, Esso Standard Oil Co.

St. Louis—Feb. 22

St. Louis Community Play House, St. Louis, Mo.; Ladies Night. A buffet supper and cocktails will be served in the Crypt beneath the theatre following the play, "Personal Appearance."

Twin City—Feb. 14

Hotel Curtis, Minneapolis; dinner 6:30 p.m. Meeting 8:00 p.m. Topics to be announced. Speakers: George F. Marks, manager, land department, Lake Head Pipe Line, Inc.; John Sigford, chief engineer — aeronautics, Minneapolis Honeywell Co.; and Walter Fenton, general manager, Metalloy Corp.

Virginia—Feb. 26

Hotel William Byrd; dinner 7:00 p.m. Meeting 8:00 p.m. Cooling System—Dan Green, consulting engineer, National Carbon Co. Social Half-Hour in the Westover Room.

Western Michigan—Feb. 20

Occidental Hotel, Muskegon; meeting 7:30 p.m. Highlights of the SAE Annual Meeting. This will be a review of several papers from the Annual meeting by local Section members who attended the sessions, with a resumé of the discussions.

NATIONAL MEETINGS

MEETING	DATE	HOTEL
	1951	
PASSENGER CAR, BODY, and MATERIALS	March 6-8	Book-Cadillac, Detroit
AERONAUTIC and AIRCRAFT Engine Display	April 16-18	Statler, New York
SUMMER	June 3-8	French Lick Springs Hotel, French Lick, Ind.
WEST COAST	Aug. 13-15	Olympic, Seattle, Wash.
TRACTOR and PRODUCTION FORUM	Sept. 10-13	Schroeder, Milwaukee
AERONAUTIC, PRODUCTION FORUM, and Display	Oct. 3-6	Biltmore, Los Angeles
TRANSPORTATION	Oct. 29-31	Knickerbocker, Chicago
DIESEL ENGINE	Oct. 29-30	Drake, Chicago
FUELS and LUBRICANTS	Oct. 31-Nov. 1	Drake, Chicago

SAE AT

BRADLEY UNIVERSITY

SAE came to Bradley University in November, 1949, when the University was fifty-two years old. It burst, rather than blossomed, into full activity. Within a few months, the new SAE Student Club had enrolled as members more than 20% of the 600 engineering students at Bradley.

Impetus for the Club's rapid success came from support and cooperation of Dean Russell H. Gibbs of Bradley's Engineering College; Vice-President Cecil M. Hewitt, an SAE member since 1919 and Central Illinois Section's longest SAE member; and Chester Linsky, engineering instructor. Caterpillar's Robert V. Larsen, last year's Student Activities chairman of the Central Illinois Section, put a big shoulder to the wheel, too.

Much of the student enthusiasm at Bradley, however, is due to the practical program of activities which was promptly set up and integrated into the school engineering instruction. Instructor Linsky tells the story this way:

"We started with a program of field trips to local industries. This sparked considerable interest in the automotive engineering field.

"Then an elaborate system of projects was set up in which SAE principles were tied in with class work. The projects involve testing and research on automotive engines. . . . SAE members also are designing and installing equipment in the mechanical engineering laboratory for testing purposes. This work, under faculty direction, gives students excellent practical experience.

"Graduating seniors are assigned to these projects on the basis of abilities for particular kinds of work. They get credit for the work as an elective course.

SAE Student Club members are drawn from all over the United States. One of the first members hailed from Sweden.

Bradley boasts a small, but distinguished, group of alumni who are members of SAE. Over half of them work for Caterpillar Tractor Co. located in Peoria along with Bradley. H. N. Metzer, who became chief engineer of Oldsmobile last December, is a Bradley man, class of '26 . . . and so is Charles J. Scranton (M '12), now chief engineer of Allis-Chalmers' La-Porte Works.

Organized in 1897 as Bradley Polytechnic Institute, the institution became Bradley University in 1946, when it was accredited to grant degrees of master of arts and master of science. The four-year college curriculum was instituted back in 1920. Automotive engineering and mechanics have occupied an important part in Bradley's curriculum for many years, though its College of Engineering came into official being in 1947. (Its School of Horology was founded in 1897.) Assisting Mrs. Lydia Moss Bradley in establishment of the university were such men as Dr. William Rainey Harper, first president of University of Chicago, and John Dewey, the noted philosopher and educational pioneer.

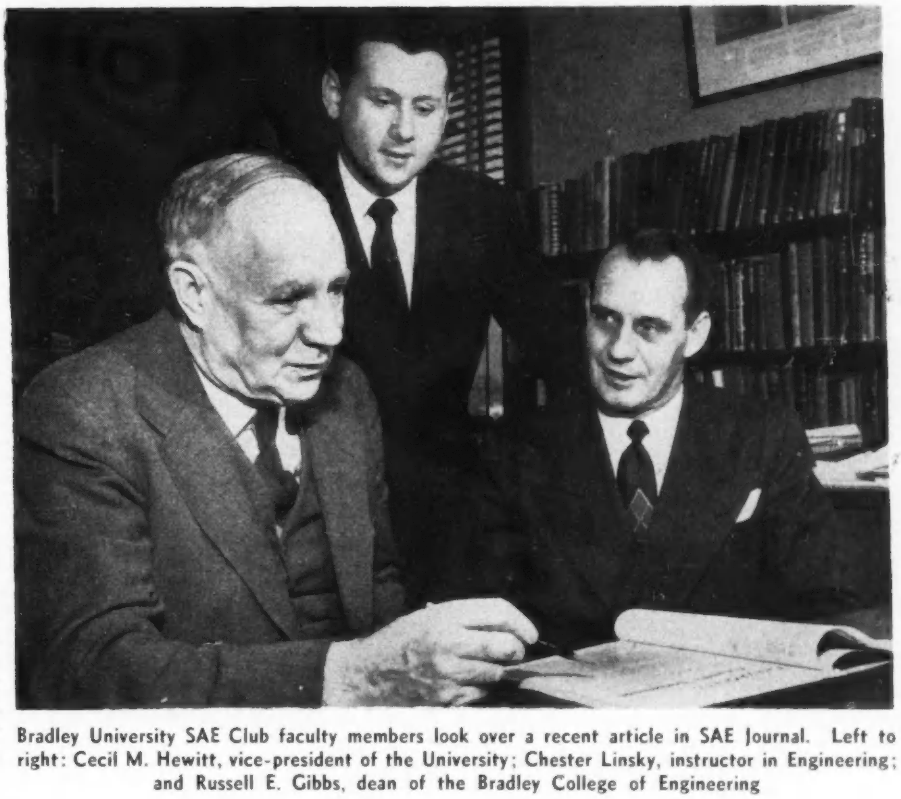
The University now has an enrollment of 3600 full-time students—with some 2000 more enrolled in its Evening Division, Home-Study Courses, and Extension Division.

In athletics, Bradley Braves are members of the tough Missouri Valley Conference, and meet such teams as Oklahoma A & M, St. Louis, Drake, Wichita, and Tulsa in football; and Tulane, Iowa State, Nebraska, Purdue, Ohio State, Georgia Tech, and other top-ranking teams in basketball. In the latter sport, Bradley was rated the Number One team in the nation in the Associated Press Poll.

SAE Members Who Attended Bradley University Include:

John M. Corkill (**1939-48**), Harold A. Fletcher (**1919-25**), Robert Catlett Howell (**1947-50**), Willard Jensen (**1941-42**), Nicholas Kent (**1937-43**), Robert V. Larson (**1931-33**), H. N. Metzel (**1922-26**), Mitchell McMurray (**1934-35**), Otto C. Reichel (**1937-41**).

Charles J. Scranton (**1906-12**), Jacob S. Smith (**1934-36**), R. H. Swartz (**1927-31**), Harold L. Ward (**1946-50**).



Bradley University SAE Club faculty members look over a recent article in SAE Journal. Left to right: Cecil M. Hewitt, vice-president of the University; Chester Linsky, instructor in Engineering; and Russell E. Gibbs, dean of the Bradley College of Engineering

Members of the SAE Student Branch at University of Oklahoma

SAE Student News

Aeronautical University

Student Branch members toured the Gary Works of Carnegie-Illinois Steel Corp. on December 15. They were taken by bus over the $2\frac{3}{4} \times 1\frac{1}{2}$ mile area, and shown the steps in the production of steel. At the coke plant they saw the 15 batteries of 1055 ovens into which is fed a scientifically determined mixture of Pocahontas coal, low in volatility, and Kentucky Lynch coal, high in volatility.

Andy Liettinen, who guided students through the plant, explained that each ton of coal carburized in these coke ovens makes 1500 lb of coke, 11,000 cu ft of gases, 13 gal of light oils, and some 8 to 10 gal of coal tar. From these by-products of the coking process come aspirin, nylon, perfumes, sulfa drugs, DDT, and phonograph records.

The students saw the 12 blast furnaces grouped in two's with their stoves between them. These furnaces are tapped about every six hours.

The Gary works has 53 open hearth furnaces. The heat in the furnace is developed from over the top of the bath by burning oil or gas. In the open hearth the steel obtains its main physical characteristics. The group followed through the process of rolling railroad rails and inspected the mills where railroad wheels are made.

—Fred J. Clemens, Field Editor

Shown at the December 11 banquet sponsored by Bradley University's SAE Club are (left to right): Richard Tringali, chairman of the Joint Engineering Council; Chester A. Arents, Assistant Dean of engineering at Illinois Institute of Technology in Chicago; and Dean Russell E. Gibbs of the College of Engineering at Bradley

Bradley University

Eighty-five members from different technical clubs at Bradley University were present December 11 at a Joint Engineering Clubs banquet held under the auspices of the SAE Club. The engineering faculty were also on hand to hear Assistant Dean Chester A. Arents of Illinois Institute of Technology speak on "The Opportunities and Responsibilities of the Engineer in 1951."

Arents said that job opportunities for the engineer are increasing and will continue to increase. In 1890, there were three engineers for every 1000 workers; in 1950, there were 13 engineers for every 1000 workers, and this figure is increasing. Because of the terrific shortage, he added, this is the "golden era" for engineers.

The engineer's responsibility has increased with his importance, too. To fulfil this responsibility, Arents said, the engineer must develop six qualities in himself and in his work: fairness, thoroughness, judgment, tact, enthusiasm, and emotional control.

—Fred R. Platt, Field Editor

Points Out Needs In Car Design

• Metropolitan Section
C. F. Foell, Field Editor

Dec. 7—An automobile must look fast, members present at this meeting were told, even when it is standing still. Speaking on passenger car styling, Industrial Designer **Raymond Loewy** added that cars should be graceful, yet dignified, with a minimum of chrome, and simplicity as the design goal.

All designs are a compromise, he said. You can't obtain yearly outputs in the millions with a multiplicity of designs, because mass production cannot support such a diversity. One of the biggest handicaps to efficient design is weight—and, of course, weight distribution.

Loewy foresees a growing influence of European car designs in American styling. He believes future designs will be a blend of the best features of each school of thought. Once the consolidation becomes effective, he expects such accessory benefits as lower center of gravity and easier steering.

Speakers' table at Metropolitan Section's Dec. 7 meeting: left to right, Speaker Raymond Loewy; Section Chairman E. N. Hatch; SAE Secretary and General Manager John A. C. Warner, and Raymond R. Faller, Ethyl Corp. Mrs. Loewy is at lower right.

SAE Section Meetings

New Detroit Activity Holds First Meeting

• Detroit Section
George J. Gaudaen

Dec. 4—This Section's new Engineering Materials Activity held its first meeting at the Rackham Educational Memorial. Molybdenum and titanium, two metals which have attracted a great deal of attention because of their potential for use in high-temperature and high-stress applications, were discussed by authorities who are in intimate daily contact with these metals.

Molybdenum, cast by an electric arc process from the powdered metal state, was discussed by **John L. Ham**, research metallurgist for Climax Molybdenum Co. Despite its high melting point (4750 F), he said, pure molybdenum has been limited in some of its applications because its strength at high temperatures was insufficient. But work with alloys of tungsten, titanium, columbium and vanadium present possibilities.

An interim appraisal of titanium was offered by **Dr. Robert I. Jaffee** of Battelle Memorial Institute, who said that titanium production today is at the crossroads while a decision is being made on method of production. Even when the decision is reached, it will be another two years before a really significant amount can be produced. He said the material's resistance to fatigue is good, and its resistance to corrosion is attracting much attention.

The speakers revealed that interest in both metals is currently high not only because of their unique properties but because of the proximity of sizeable reserves of the metals. Molybdenum is now being mined in Colorado, while titanium reserves are scattered all over North America, with deposits now being developed in Quebec reported to have a potential of 125,000,000 tons.

Ingot production of molybdenum and titanium has been under way only very recently. Climax became interested in production of pure molybdenum in 1943 and was able to turn out bars of the metal in 1945. Ham revealed that today ingots are being cast up to 7 in. in diameter. Production of pure titanium was started in 1946, when the United States Bureau of Mines pilot plant began operation, turning out about 100 lb per week. Since that time three private firms have also been turning out titanium

Some of the founders of Detroit Section's Engineering Materials Activity, with the two speakers, shown at the Activity's inaugural meeting on Dec. 4. Left to right: J. L. McCloud, Ford Motor Co.; Speaker Dr. R. I. Jaffee, Battelle Memorial Institute; A. L. Boegehold, General Motors Research; Speaker John L. Ham, Climax Molybdenum Co.; F. P. Zimmerli, Barnes-Gibson-Raymond Division, Associated Spring Corp.; and H. B. Knowlton, International Harvester Co.

ingots, some of which run to 6 in. Current output is about 300 tons a year.

While both metals have certain desirable qualities which make their development worth while, both speakers pointed out that they are also possessed of characteristics that limit their application in many uses unless they are combined with stabilizing metals or protective coatings. Thus molybdenum needs some alloy to give it greater strength at high temperatures and a coating to protect it from oxidization. This function is satisfactorily performed by molybdenum silicide. Titanium's principal drawback appears to be its galling tendency, and investigations are being conducted toward developing a satisfactory plating material to combat this.

Both metals seem to have immediate military applications: molybdenum for use in components of turbojets and ramjets and possibly in nuclear reactors, and titanium in aircraft engines and thermal de-icing units.

"Titanium's ballistics properties make it worthy of serious consideration for use as armor," Jaffee said. "Further, because its resistance to marine corrosion is excellent, its possible naval uses appear to be extensive."

In the opinion of both speakers, improved production methods and accompanying lower prices will see much more extensive use of the two metals. Current prices (about \$10 to \$13 per lb for molybdenum in ingot form, and \$6 to \$10 for titanium ingots) have restricted the metals to none but experimental uses.

Rotators Increase Valve Performance

• New England Section
Chris G. MacDermot

Jan. 2—Fuels and lubricants used are not the only determining factors in valve performance and life, according to **H. C. Sumner** of Ethyl Corp. Engine design and operating conditions are also important variables. Thus the valve rotator is a modification which can be and has been successfully applied to most types of automotive engines to improve valve behavior. Rotating valves have been found to reduce stem deposits which result in sticking, and to reduce localized leakage and resulting overheating at valve faces. Face and seat deposits are also reduced.

Three types of rotators are in use at the present time; two depend on engine vibrations and gas flow for rotation, and one is a positive type that turns the valve two to three degrees on each lift. The use of hard-faced and non hard-faced valves in tests which Sumner supervised was compared; results showed hard-faced valves should always be used in conjunction with rotators if good results are to be obtained in heavy-duty service. However, vehicles not in heavy-duty service benefit from the use of rotators without using hard-faced valves.

Any possibility that rotators contribute to valve breakage, Sumner said, seemed to be discounted by the results of Ethyl Corp. tests. Following correct installation and service procedures is important to insure good results from rotators, but little trouble was encountered when rotators were installed by the various operators' regular personnel. It is of obvious economic benefit to vehicle operators to have valve service intervals coincide with piston

ring replacement time. In operations where this has not been possible before, and intermediate valve service was necessary, valve rotation combined with careful valve reconditioning has provided the answer in the majority of cases.

Discusses New Cummins Engines

• Northwest Section

Kenneth A. Short, Field Editor

Nov. 3—Higher horsepower outptut engines with lower weight per horsepower and higher rotative speeds are the prime objectives in the diesel engine field, according to **Harold H. Hall**, general service manager of Cummins Engine Co., who described some of the steps his firm is taking to attain these goals.

Among the Cummins developments detailed in Hall's talk were:

• The new DD fuel pump, which gives good fuel distribution at higher speeds while reducing size and weight, and at the same time extending service life;

• The NHRS engine, which develops 300 hp at 2100 rpm, with 743 cu in. displacement, and at a weight of 9.1 lb per hp; important in achieving these results were use of the DD pump, improved valve timing, supercharging, fully counterbalanced crankshaft, new injector cups, and use of a heat shield between the intake and exhaust manifold connections;

• The NVH and NVHS engines, which are V-type, 12-cyl, 1486 cu in. displacement, developing 400 hp naturally aspirated and 550 hp supercharged, of 10.7 and 8.3 lb per hp respectively. These engines are used in many stationary, marine, and railroad, as well as logging and earthmoving, operations, where a durable engine of high horsepower and relatively small physical dimensions is required.

• The model JBS engine, developing 150 hp at 2500 rpm, with 401 cu in. displacement, for use in trucks of the 45,000 to 55,000 gvw range. A revised JBS engine was produced to power the diesel race car entered in the 1950 Indianapolis race, which developed 340 hp at 4000 rpm. The car was forced out on the 52nd lap by a broken torsional vibration damper, but subsequently established six world records for diesel-powered cars at the Bonneville salt flats.

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Past Chairmen Honored At New England Section

• New England Section
J. S. Walker, Field Editor

Dec. 5—This was a double feature meeting, with a speaker who discussed New England's community airline, and a past-chairmen's night at which 12 of these officers were present. Past-Chairman E. C. Guiou showed some excellent color movies and slides of past annual outings, and additional pictures taken by Glenn Whitham were included.

Joseph Garside, president of Wiggins Airways, illustrated the importance of airline service and feeder lines with the following observations:

1. Feeder lines serve cities that otherwise would not have plane service;

2. They must meet all safety and other regulations met by trunk airlines;

3. Feeder lines do not compete with larger lines, but actually stimulate business in the communities served;

4. Feeder lines provide a reserve of qualified pilots, technicians, and other trained personnel to fill emergency needs;

5. Feeder lines eventually may develop a specialized type of plane, Garside believes, that will operate from the heart of a city;

6. Development and progress have been rapid enough so that Garside feels it will not be too long before special short-haul planes can travel from city to city as cheaply as planes.

The past-chairmen all took a bow, reminisced, and had a general good time. Anecdotes and "do you remember" stories were heard in all corners. The following were present: J. F. Shannon, J. A. Hassey, E. N. Smith, M. R. Wolfard, Robert Lybeck, D. A. Fales, Robert Gardner, Albert Lodge, E. C. Guiou, H. F. Fritch, H. B. Hawk, and G. S. Whitham.

"Town and Country" Gear Described

• Central Illinois Section
Harlow Piper, Field Editor

Dec. 11—A town and country gear for semi-automatic transmissions was described at this meeting by **Alfred W. Sieving**, design engineer for Caterpillar

Again...HYATTS preferred

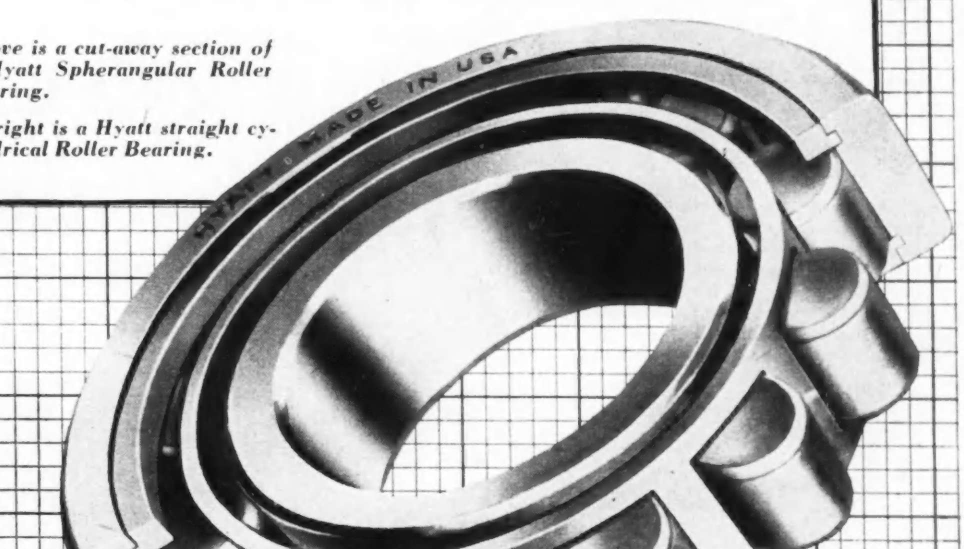
No design-engineer will continue to specify Hyatt Roller Bearings, year after year, except for one reason—Hyatts do the job better.

In most 1951 cars, trucks, and buses, Hyatts are preferred for differentials . . . rear wheels . . . pinions . . . transmissions . . . steering gear and other positions.

The 1951 models have one thing in common with cars and trucks of the early nineties, Hyatts are used now as then, for reliable performance. Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Detroit, Mich.

Above is a cut-away section of a Hyatt Spherangular Roller Bearing.

At right is a Hyatt straight cylindrical Roller Bearing.



HYATT ROLLER BEARINGS

Tractor Co. By changing gear ratios and adding a planetary unit which fits into the present standard transmission case, excellent starting, accelerating, and cruising gear ratios are obtained. For town gear operation, third and fourth gears are used; for country gear operation, third, fourth, and fifth gears are used.

With these changes, Sieving claimed, the following performance characteristics are obtained:

1. Faster getaway because of improved third gear starting characteristics;

2. Less "back and forth" shifting at lower car speeds because shift occurs at 9 mph instead of 12 mph;

3. Faster shifting because synchronization is faster with gear ratio of 1.55 to 1 instead of 1.75 to 1;

4. Faster and smoother acceleration with new axle ratio of 4.3 to 1 as compared to 3.54 to 1;

5. Greater economy and smoothness of operation in cruising gear with 0.722 to 1 planetary ratio;

6. Faster "kickdown" or passing gear by using fourth or direct gear instead of third;

7. Decreased loading of main transmission gears and bearings by using direct gear for acceleration and thus avoiding high gear velocities and increased bearing loadings by acceleration in second overdrive with conventional transmission and overdrive unit.

8. Less objectionable "lugging" of engine in fourth or direct gear. Engine life will be greatly increased through reduction of pin and bearing loads.

Urges Care In Truck Selection

• Kansas City Section

R. W. Laing, Field Editor

Jan. 10—Truck operators today are concerned mainly in cutting costs, and any design change in trucks should always be made with that thought in mind, said **Bert H. Paff**, branch manager of International Harvester Co.

When an operator purchases a truck, the truck salesman should be informed of what it's to be used for, where it is to be used (type of roads or section of the country), the weight to be carried, the speed at which the unit is to be

driven, and the type of service (such as start and stop operation). From this information the truck salesman can tell the operator which truck is best for his type of service. It is to the operator's advantage to supply all pertinent operating facts because he is investing an initial cost of approximately one-fourth the total final investment in maintenance and operational costs. If the truck is selected wrongly, the initial cost would probably be less than one-fourth the total cost because operational costs would run out of proportion.

Paff predicted that in the larger gasoline powered internal combustion engines, valve-in-head engines would almost completely predominate the field because of (1) higher compression engines, (2) better torque characteristics, (3) more power, (4) smaller displacement, and (5) more economy of operation.

Other important truck design features were discussed as follows: (1) accessibility for preventive maintenance, (2) easy overhaul, (3) easy-handling clutches, (4) transmissions up to 10 forward speeds and the synchro-mesh, (5) differentials, (6) the use of hypoid gears, (7) the development of a simple two-speed transmission for milk-truck type of delivery units, (8) cab vision, (9) chassis design, (10) tire selection, and (11) wheel bearing loads.

If a truck is to be used over 100,000 miles per year, Paff advised that the operator should seriously consider the use of diesel-powered units. Another development to watch is that of propane gas instead of gasoline.

Tells of Advances In Cargo and Troop Carrying

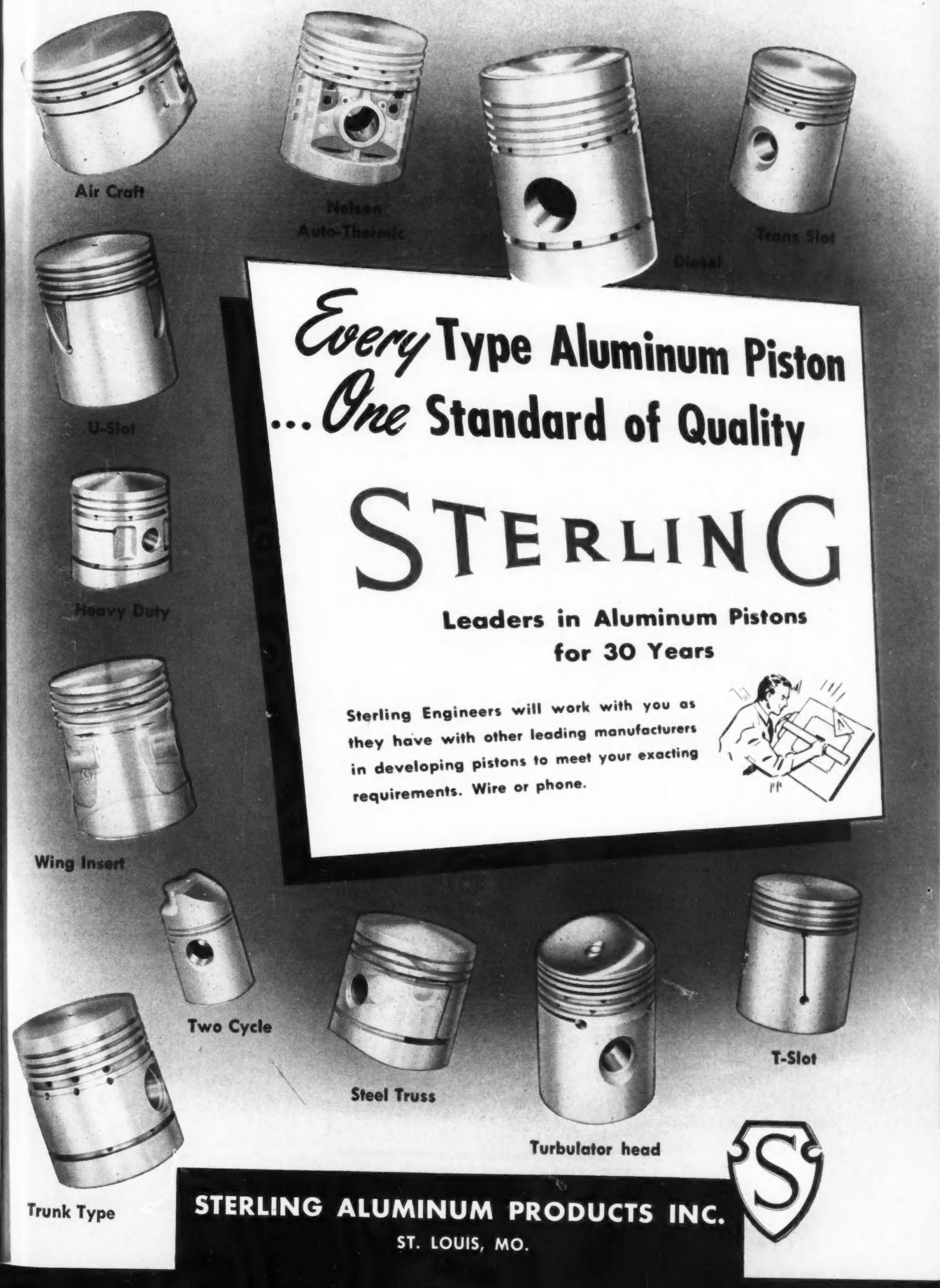
• Philadelphia Section

M. A. Hutelmyer, Field Editor

Dec. 13—Past, present and future of assault and troop carrier aircraft were discussed at this meeting by **Major Floyd J. Sweet**, chief of the cargo unit, aircraft and guided missiles section of the Air Materiel Command.

Sweet reviewed the development of gliders and troop-carrying planes in World War II by both Germans and Allies, pointing out that the equipment then used, while the best available, was unsatisfactory for both cargo loading and jumping of troops. Since the war, new equipment developed will permit the jumping of twice the number of troops at the same time, thus saturating the drop zone more effectively with fewer aircraft. It is also possible now to deliver additional equipment simultaneously by the use of an aerial delivery system called a monorail. The art of parachuting larger, heavy pieces of equipment has been perfected to the point where single pieces up to 10,000 lb can be dropped.

Sweet then outlined uses of assault and troop carriers in future air invasions, and suggested plane design related to these uses. He said the cockpit must have good forward and downward visibility, controls that could be handled with the least number of lost motions and proper grouping and lighting of flight instruments. The cargo compartment should be rectan-


Air Craft
Nelsen Auto-Thermic
Diesel
Trans Slot
U-Slot
Heavy Duty
Wing Insert
Every Type Aluminum Piston
... One Standard of Quality
STERLING
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Sterling Engineers will work with you as they have with other leading manufacturers in developing pistons to meet your exacting requirements. Wire or phone.
Two Cycle
Steel Truss
Turbulator head
T-Slot
Trunk Type
STERLING ALUMINUM PRODUCTS INC.
ST. LOUIS, MO.

gular in plan form and cross-section with a rear opening exposing the entire usuable cross-section and an integral ramp as part of the closure. The cargo floor should be level in the leading position and not higher than a truck bed from the ground. The cargo floor should be designed with strong treadways.

Other items deserving attention, he said, are landing gears (the tricycle gear has been found most satisfactory); low maintenance and easy ground handling; and the storing of as much fuel as possible in jettisonable tanks.

Sweet concluded by tracing the history of assault aircraft from its original conception as a self-propelled glider to the present development. He also touched on the possibilities and limitations of rotary wing aircraft.

Tells Fuel Problems Of Railroad Diesels

• St. Louis Section

C. R. Feiler, Field Editor

Dec. 12—The present day railroad diesel engine fuel specification is too rigid, claims **H. D. Plumly,** petroleum chemist for the Baltimore and Ohio Railroad. This rigid fuel specification requires the railroads to purchase the equivalent of #2 distillate oil in direct competition with the residential heating oil burner, in order to insure satisfactory operation of their diesel equipment. This is playing "second fiddle" inasmuch as the railroad diesels consume only 27% of the #2 distillate output as against 62% for the domestic oil burner.

Plumly then suggested ways and means to relieve this situation:

1. Increase the production of desirable fuels.
2. Determine by actual service tests the range of fuel quality which existing engines will satisfactorily burn.
3. Improve engine design.
4. Use of special heavy duty lube oils to neutralize the effect of high sulfur fuel.
5. Use of fuel additives.

Cites Essential Character Of Passenger Automobile

• Indiana Section

Dec. 14—The automobile has become the fourth basic essential of life, according to **Christy Borth,** education director of the Automobile Manufacturers Association. Although this fact still is not generally recognized, he said, the speed with which Americans transformed this vehicle from an imported luxury to an essential transport tool in 50 years is amazing.

Speaking at Indiana Section's banquet in the Antlers Hotel, Borth traced the steps involved in this transformation. It began, he said, at the end of World War I, and it was the enclosed all-weather body that enabled the automobile to become an essential tool. "In 1919, almost 90% of passenger cars sold were open models; by 1929, the reverse was true. . . ."

Other factors responsible for the transition, according to Borth, were technological advances made in World War I, and our entry into an era of

highway building after 1921.

Partially completed 1950 census figures, Borth said, show that the essential nature of the passenger automobile has increased greatly in the past 10 years. "When the Federal Government had to consider this problem in its planning for World War II, he said, "the discovery was made that some 13 million Americans in suburbs relied entirely on automobiles for transport. . . . Over four-fifths of the nation's growth in the last 10 years occurred in 168 metropolitan areas, and the suburbs showed the greatest growth. . . .

"The suburbs are now growing two and a half times as fast as the national rate of growth, while the rate for the central cities is falling short of the national average."

Borth quoted Leon Henderson, wartime administrator of OPA, on the essential character of automobiles:

"The reliance on the automobiles or rubberborne transportation is considerably more than even the loftiest statements made by the industries connected with the making of automobiles and tires. What might seem to have been a matter of trade booming as to the importance of automobiles by interested trade associations or businesses was a considerable understatement, as we have come to know."

Hear Navy Men Discuss Jet Costs

• San Diego Section

Charles F. Derbyshire, Field Editor

Jan. 9—General overhaul costs for Navy jet engines will closely parallel costs for piston engines, according to **Capt. A. L. Baird** and **Lt.-Com. N. O. Wittman**, USN. Parts cost for jet engines is not as high as for their piston engine counterparts, but closer tolerances and resultant higher inspection costs tend to bring expenses to a similar level. Production line methods applied to cleaning, disassembly, inspection, and reassembly, as well as close regulation of parts identity, result in uniform, high quailty overhaul, producing engines with service potential equal to the new engine.

Supply of LP-Gas Called Plentiful

• Mid-Continent Section

D. W. Frison, Field Editor

Dec. 8—One hundred forty members and guests of this Section gathered in Ponca City to hear of the rapid advances being made in the use of liquefied petroleum gases as motor fuels.

F. E. Selim, supervisor of LP-Gas sales, Philgas Division, Phillips Petroleum Co. covered not only the availability and supply of this material throughout the nation but also its use in internal combustion engines. He said the supply of LP-Gas exceeds any forseeable demand for present or future uses. The supply is great enough to meet the requirements for fueling all farm tractors, all trucks, and all buses in addition to a normal increase in requirement for present uses.

The use of LP-Gas as motor fuel will go far in eliminating such troubles as


STROMBERG
CARBURETORS
Judge Value As Your Customers Will — on Lasting Performance!
The performance of the car you build and sell *today* may very well be the deciding factor in some *future* automobile sale. It is just good business, therefore, to choose your engine components on the basis of *long-range economy*. In carburetors, the name Stromberg is famous for better performance —it is also a fact that Stromberg Carburetors *last longer*. Judge value as your customers will and you will agree— Stromberg* Carburetors are the logical choice.
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ECLIPSE MACHINE DIVISION OF
• Standard Equipment Sales: Elmira, N. Y.
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Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.
40 50 60
30 70
20 80
10 90
0 999990 100

intake and combustion chamber deposits, oil dilution and contamination, spark plug fouling, and so forth.

Engines of higher compression ratio, such as those now available, along with increased combustion efficiency and the elimination of fuel distribution problems compensate for the lower heat content of LP-Gas so that fuel economy equivalent in miles per gallon to gasoline are obtained.

While nationwide distribution of LP-Gas for use in commercial vehicles is not available at present there is a framework in existence for such a distribution system which can be expanded as rapidly as the demand will justify the installation of the necessary additional facilities.

LP-Gas can be used in automotive vehicles at least as safely as other fuels as long as the basic rules for the design, installation and maintenance of equipment are followed.

Tells Steps in Lube Oil Refining

• Dayton Section

Lewis A. Leonard, Jr., Field Editor

Dec. 13—How high-quality lubricating oils are refined was discussed by **M. S. Obenauf**, head of lubricating sales promotion for Standard Oil Co. of Ohio. Obenauf explained in detail the solvent refining method now employed at the newly-erected plant near Lima, Ohio, the tallest industrial structure in Ohio.

Depending on the final product desired different crudes are selected. At this plant, Illinois crude is used almost exclusively. Only 40% of the crude is further refined after the crude distillation. Of this 40%, 24% is gas oil, 13% asphalt, 20% is extract, 9% wax, 1% color bodies; and 33% high quality lubricating oils.

Refining requires five steps, the speaker said:

1. The vacuum distillation unit;
2. The propane de-asphalting unit which rejects the asphalt. (These two units improve color, carbon residue, and flash-point);
3. The furfural extraction unit, which improves color, odor, viscosity index, oxidation stability, and specific gravity;
4. The MEK de-waxing unit using methyl ethyl ketone as the solvent, which removes wax and improves pour point.
5. The clay contact, which uses filtrol clay to remove and/or improve color and odor.

With the exception of the clay, all other solvents are reclaimed for reuse.

25 Years Ago

Facts and Opinions from SAE Journal of February, 1926

Headlights of the future, according to Walter D'Arcy Ryan of General Electric Co., "should have range without dangerous glare and should not require tilting, dimming or any other form of manual operation. The two-filament lamp, if put into use, rapidly and extensively would, he feels, do much to improve the present situation.

■

Ultimately all motor coaches will be equipped with power brakes, it was predicted in a paper written by R. R. Fageol, vice president, Fageol Motors Co. Such brakes may be made compulsory in many places by special legislative action within the next five years, he said.

■

Speaking of the Auburn car at a Metropolitan Section banquet, J. M. Crawford, chief engineer of Auburn, said that, in an effort to correct tramping, the side rails of the 1926 model frame have been increased to 7/32 in. thickness, 6 in. depth and 2½ in. flange. . . . Speaking for Buick, chief engineer E. A. DeWaters said 1926 model changes include a 16% increase in powerplant output, addition of air cleaners, oil filters, and gasoline strainers—and fitting of dust shields to the drums of the external four-wheel brakes.

■

R. E. Carlson, Bureau of Standards, at a Washington Section meeting described controllable beam equipment that enables the main beam from a headlamp to be depressed at the will of the car operator, together with two-filament headlight control. The principles of depressible beams, he said, is being widely adopted and is a logical extension of the present system that should go far toward improving headlighting conditions.

■

Prevention of oil-dilution troubles by use of a pre-diluted oil was the startling recommendation made at an An-

25 Years Ago

nual Meeting Fuels and Lubricants session by Robert E. Wilson and Robert E. Wilkin, Standard Oil Co. of Indiana. These authors proposed that an oil suitably diluted to approximately equilibrium value of the average dilution of oils in cars in operation be used.

■

Following a visit to United States, Ernst Neuberg, director der Deutschen Automobil-Constructionsgesellschaft, m.b.H., Berlin, wrote to SAE headquarters that:

"While America has a much greater market for and is far ahead in the production of passenger cars, this cannot be said in regard to motor trucks and tractors. German firms can compete in design, production and price of the latter."

■

An all-metal airship (Metalclad) described in a paper by Ralph Uspon, its designer, was said to meet the following requirements: (1) fireproof, (2) weatherproof, (3) durable and permanent in structure, (4) navigable in practically all kinds of weather, and (5) economical in use of buoyant gas and ballast.

■

"Warfare in China is becoming civilized and touches the lives of the people more and more. . . . Very few people, either Chinese or foreign, will suggest that the end of Chinese civil strife is in sight. . . . We should remember that what happens does not depend solely on what happens on that side of the water, but also on what happens here, now, and with us. It is extremely important that we learn the real facts, that we insist that our representatives keep in touch with the real situation."—H. T. Lewis

■

"If the fuel characteristics could be changed gradually as cold weather approaches," says John O. Eisinger, "somewhat as the distillation curves and the starting performance of different fuels at various temperatures indicate desirable, it might be possible to get very nearly the same starting performance in winter and in summer."

Eisinger presented a paper on some Bureau of Standards Researches, one purpose of which was to determine the general nature and magnitude of the fuel changes that might accomplish this result.

Cub Tractor Engine

Continued from Page 79

Motor Oil, as defined in the SAE Handbook, to the 2-104B Supplement 1 oil, in both the Cub and Chevrolet L-4 engines. In fact the engine deposit ratings of these oils in the Cub are spread over a wider range than in the L-4, which is desirable for two reasons.

First, it is possible to classify more definitely the quality level of unknown oils. Second, it permits closer selection of the additive concentration to satisfy a given performance requirement.

The plot of bearing weight losses in Fig. 2 shows very close agreement between Cub and L-4 tests.

Cub FL-2 test results also correlate very well with Chevrolet FL-2 results. This is demonstrated in Fig. 3, a comparison of deposit ratings of various gasolines, and Fig. 4, comparative piston skirt ratings for these fuels.

We feel the results justify our selection and use of the Cub engine. (Paper "Small Engines and Dynamometers for Pilot Testing," was presented at SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 9, 1950. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Preventing Vapor Lock In Personal Airplanes

Based on paper by

L. I. YORK

Continental Motors Corp.

A. HUNDERE

California Research Corp.

R. A. COIT

Shell Development Co.

BEST way to minimize the tendency to vapor lock in personal airplanes is to keep all fuel system parts at minimum temperature and maximum pressure.

Taking the fuel tank first, the fuel outlet should be at the lowest point in the tank. This prevents pumping of air at low fuel levels. A hopper bottom is desirable. Where multiple outlets are used in the fuel tank, they must be Y'd together at a station low enough so that this location is always flooded with gravity-fed fuel from the tank.

Tank vent pressure should not be negative under any flight conditions. With a multiple tank installation, the tanks should be vented to a common external vent if normal procedure allows flow from more than one tank at the same time. Otherwise, the tank with highest pressure will transfer fuel to the other tank and force some fuel out its vent. Simplest solution is a selector valve permitting separate operation on each tank.

The fuel selector valve should be designed to insure full indexing of all ports. Partially indexed ports cause fuel system restrictions.

The fuel strainer should be exposed to as little engine heat as possible. The pressure drop across the filter should be a minimum consistent with good filtering and size. Installations where the filter operates under negative pressure should be designed to be readily maintained free of air leaks.

Fuel lines should have minimum pressure drop and transfer minimum

heat to the fuel. They should have the fewest number of bends, elbows, and connections. Information from extensive studies of pressure drops across component parts of aircraft fuel systems is summarized in the 1946 CRC Handbook.

The fuel pump on a pressure system should be heat-insulated from the engine and have baffled cooling air to keep pump metal temperature at a minimum. The capacity should be three to five times maximum engine fuel needs so that reserve capacity can be used to handle vapor.

Fuel should be pushed rather than pulled, wherever possible. In pressure sytems with tank level below the engine pump, a boost pump is desirable for emergency and auxiliary use. The centrifugal submerged fuel tank pump is ideal for this purpose.

The fuel system should not be considered satisfactory for service unless it can handle an 8-lb fuel on a 100 F day with no loss in fuel flow from vapor formation.

These recommendations stem from tests on five airplane makes, a project of the Aviation Fuels Division, of the Coordinating Fuel and Equipment Research Committee, CRC. (Paper "Recommendations for Fuel System Design for Personal Aircraft with Regard to Vapor Lock," was presented at SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 10, 1950. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Titanium Alleviates Columbium Shortage

Based on paper by

JOHN F. TYRRELL

Solar Aircraft Co

THE already tight supply of columbium is due to become even more critical as jet engine needs accelerate. Titanium can ease the situation by replacing columbium as a stabilizing agent for stainless steels. Engineering properties and service behavior of titanium-stabilized steels are as good as those of columbium alloys, while titanium steels are easier to fabricate and cost less.

Tensile strengths of AISI Type 321 (titanium-stabilized stainless) and of AISI Type 347 (columbium-stabilized stainless) differ little. Resistance to creep, important to load-carrying ability above 800 F, is a little better in Type 347. But this difference may be insignificant for design purposes.

Strength of both alloys decreases rapidly above 1500 F. But tests at

Solar showed Type 321 to be about twice as resistant to oxidation at 1850 F as Type 347 in 400 hr of exposure. The difference is even greater for short exposure periods.

Solar's experience indicates titanium-stabilized alloy will perform satisfactorily in reciprocating engine exhaust systems, jet tailpipes, exhaust cones, aft frames, outer combustion chambers, and other parts operating under about 1500 F. At least six engine sets on the DC-4 exhaust system, built by Solar from Type 321 material, have completed over 3000 hr service in an application for which the guaranteed life is 300 hr.

In resistance welding—spot or seam—there is no real difference between the two steels. But Type 321 is superior to Type 347 in fusion welding by the inert gas-shielded arc process. In manual welding by this process, an average welder can produce about 300 in. more per day on welded seams with Type 321 than Type 347. And Type 347 averages about five times as much weld repairing as Type 321.

Welding rates are 150% faster for the titanium steel in automatic machine welding by the inert-gas process.

Many stampings that could not be made from Type 347 were successfully formed from Type 321. Investigation showed that Type 321 can be deformed about 5% more than Type 347 before localized thinning occurs in drop hammer forging. In deep drawing, Type 321 can be drawn about 10% more than Type 347.

Stabilized stainless steel castings almost always are made from Type 347 because of titanium loss from molten metal. Experimental heats showed it possible to produce successful castings from Type 321 material by modifying the alloying practice to offset the high titanium loss. (Paper "Conservation of Columbium," was presented at SAE San Diego Section, Oct. 10, 1950.)

Life Expectancy Records Aid in Truck Servicing

Based on paper by

F. WILLARD SMALLEY

International Harvester Co.

THE purpose of truck servicing is to get every possible trouble-free mile out of the truck, regardless of size or operation, at the lowest possible cost per mile, but without road failures.

It is important to remember that we can't get something for nothing. When a unit—be it engine or rear axle, generator or brakes—has lived a life that experience has taught us is all that we can expect, we must replace it if we are to keep the wheels rolling.

Today, basic equipment is lighter,

payloads are heavier, and schedules are faster than ever before. Under these conditions, only with the removal of units for overhaul at definite periods before failure can we attain long service life for our vehicles and eliminate road failures.

The life expectancy of each chassis unit should be determined—and it should take into consideration the type of operation. Many fleets use expectancy records, which they have developed. Others compile records of failures, tire mileage, mileage at which fuel consumption is increased, and so on; but if they fail to interpret them in terms of what will happen to each similar unit in the fleet, a $100 road failure of a truck carrying a perishable load can pyramid into a $2000 loss. If new units are involved, it is desirable to consult the service manager of the chassis manufacturer for their life expectancy.

Rebuilt Parts

Truck manufacturers recognize the necessity of keeping trucks rolling and the limited time available for making repairs. For this reason many of them have set up—at great expense—large unit-rebuild plants to rebuild all components, such as engines, transmissions, rear axles, fuel pumps, distributors, and carburetors. They are selling them on an exchange basis through their regular service parts outlets.

It is obvious that on any program of this kind, where large distribution is necessary, comparatively high production must be had to make an exchange plan economically feasible.

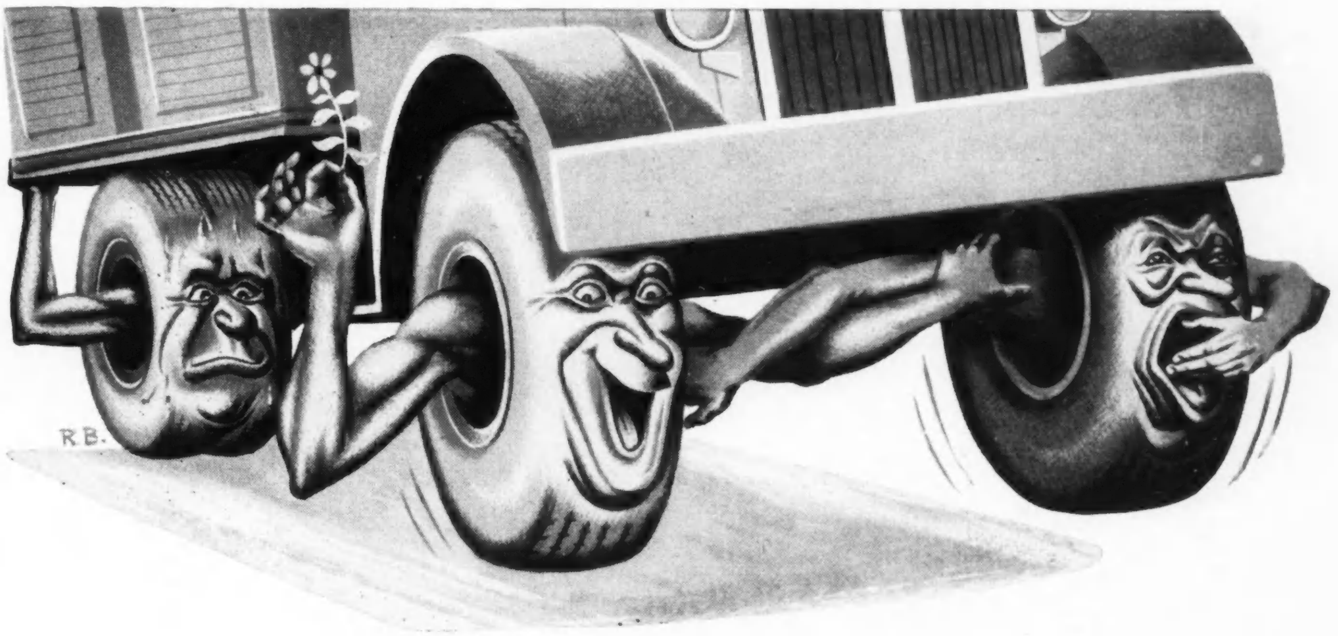
Whether or not an operator wants to use a factory rebuild plan or to maintain shop facilities to rebuild his own units and what percentage of exchange units he can afford to stock depends on a great many variables.

If it is a large fleet, operating out of central points, using large numbers of identical vehicles, then setting up shop facilities for rebuilding one's own units and carrying spare units (engines included) is practical.

If the fleets are varied or operating in small groups, then either his own maintenance crew for running repair and depending on vendor exchange units or vendor service stations is a practical answer.

Even the one or two-truck operator has today an opportunity to take advantage of exchange units and good, well-equipped vendor service stations.

(Paper, "Service of Truck Transportation and the Use of Rebuilt Major Components," was presented at a meeting of the Northern Calif. Section of the SAE, San Francisco, Jan. 16, 1950. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)



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Applications Received

The applications for membership received between Dec. 10, 1950, and Jan. 10, 1951 are listed below.

Atlanta Group

Tom Turney.

British Columbia Section

William E. Atkinson.

Buffalo Section

Donald Otto Oetinger.

Canadian Section

Richard H. Howell, Lt.-Col. Peter C. King.

Chicago Section

L. W. Ehlers, Frederick H. Engelke, Ralph Clinton Goetz, Ralph L. Handy, George A. Jergenson, Sherman M. Katz, C. Hyatt King, P. H. Korrell, Horst Muller-Carioba, Charles J. Parker, Donald A. Steszewski, Joe Valence.

Cincinnati Section

Robert B. Bing, Paul G. Blazer, Jr.

Cleveland Section

Carl M. Bliss, Richard F. Fitzgerald, Wilbur J. Scheutzow, William Tnorrat.

Detroit Section

Charles C. Adams, John Arzoian, Charles L. Burleigh, Joseph J. Coury, Edwin A. Desmond, Jr., Joseph H. Fox, Clarence Gaughen, Kenneth Owen Glattes, John T. Hadwin, Jr., John T. Hoban, Harold V. Joyce, Johannes Kamuk, Howard E. Lukey, John F. McLean, Jr., Rowland George Oonk, Edward K. Pilcher, Robert F. Ploeger, Jack Prendergast, Lee William Rehbein, Karl Melton Unser, James T. Werner, Howard H. Wilder, Marion A. Witowski.

Metropolitan Section

Edward J. Crowley, John A. Jones, Jr., John B. Moore, Emanuel Steinberg.

Mid-Continent Section

Marinus Flux.

Milwaukee Section

Ralph E. Berndt, E. C. Brekelbaum, James F. Johnson, Jr., Rupert J. Loeffler, Jr., W. H. Stark.

Montreal Section

John S. Brock.

New England Section

Hans Lanz.

Northern California Section

Letcher H. Cope, Horace Holmes, Rowan McCarn.

Continued on Page 114

Applications Received

Northwest Section

Andrew C. McDermott, David A. Tozer.

Oregon Section

Raymond H. Wolfgram, John C. Worthington.

Philadelphia Section

Warren E. Barker.

Pittsburgh Section

Maynard W. Teague.

Southern California Section

Edward R. Daley, Edward Henry Ledbetter, Francis L. Moseley, A. F. Reznicek, Samuel J. Smyth, Morgan L. Sweeney, Jr.

Southern New England Section

Edwin Braverman, Stanley M. Terry.

Syracuse Section

James D. Cregan, Glen H. Dingman, Edwin Roy Smith, Harold R. Turner.

Texas Section

C. E. Hale, Robert R. Jameson, Ollie James Smith.

Twin City Section

Lawrence G. Boschma.

Virginia Section

W. I. Shipp.

Outside of Section Territory

Archie D. Dennis, Daniel Fort Flowers, Francis Thomas McGuire, Pedro Juan Sintes, John Alex Steeves.

Foreign

Kanahala Bandaralage Lawrence, Perera, Ceylon.

New Members Qualified

These applicants qualified for admission to the Society between Dec. 10, 1950 and Jan. 10, 1951. Grades of membership are: (M) Member; (A) Associate; (J) Junior; (SM) Service Member; (FM) Foreign Member.

Baltimore Section

Richard G. Shanklin, Jr. (J).

Buffalo Section

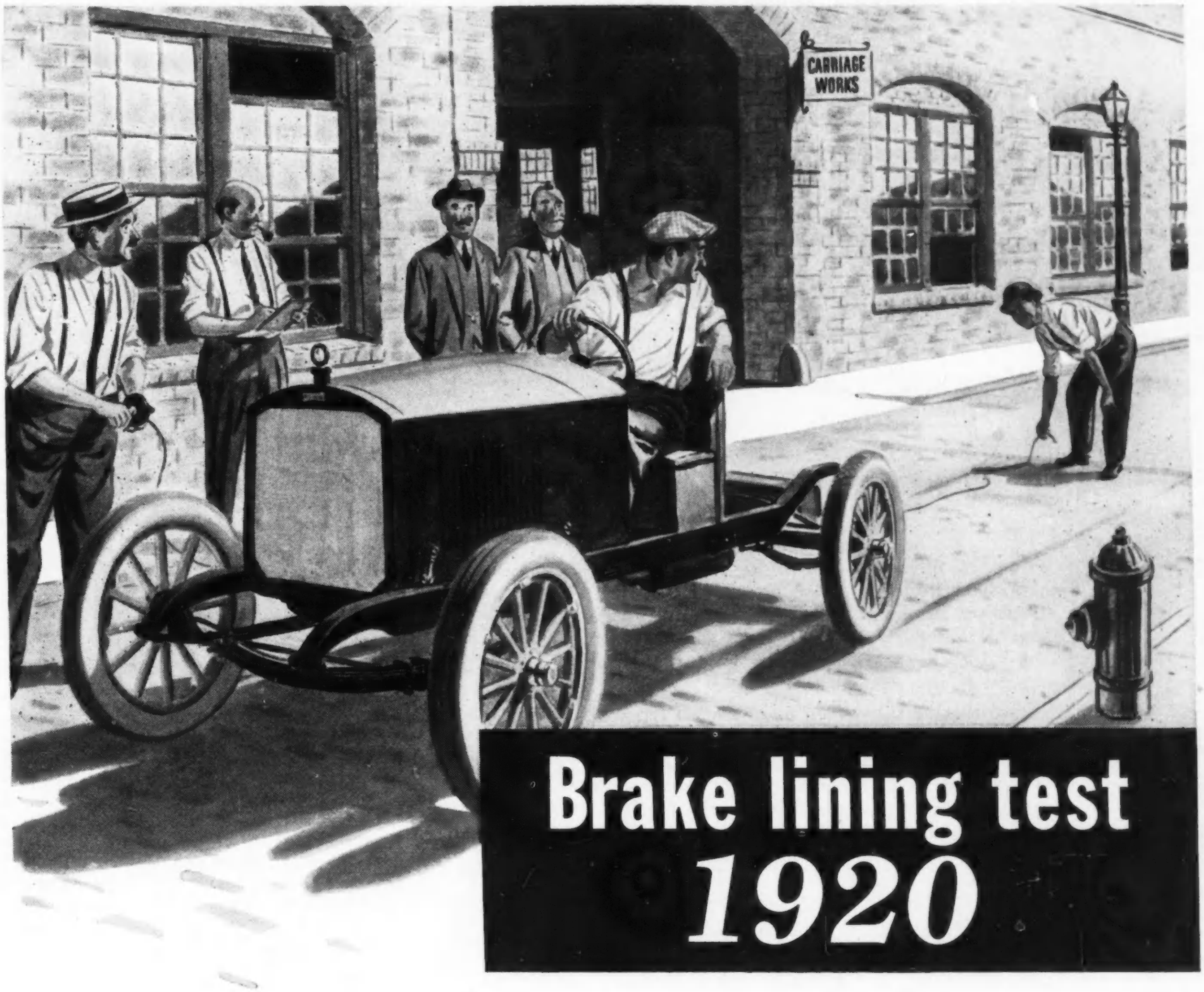
Howard A. Mason (M).

Canadian Section

Edward Marshall Bauder (J), Albert Jervois Dewdney (M), Bert Hannaford (A).

Chicago Section

Norman Roland Cooper (J), John J. Corrigan, Jr. (J), Norman G. Esbrook



Brake lining test
1920

Just 30 years ago a car manufacturer tested brake lining by installing it on a test chassis, accelerating the car to 30 or 40 miles per hour, then applying the brakes when the car passed a predetermined line.

The distance it took to stop the car determined the lining's performance. Mileage? Who cared—as long as the vehicle could be stopped.

Contrast that with today. At Brakeblok, for example, our lining comes into being as the result of tests. We create friction materials in our laboratories to meet these tests. We prove the materials in our Dynamometer Room—for fade, deceleration, heat, reaction to moisture and other conditions. Then we put them on our Test Fleet, subject them to actual driving conditions.

Result—we know a great deal about all kinds of friction materials. We can't think of a one we are not intimately familiar with.

We offer this experience and knowledge to you . . . to help you equip your vehicle, be it car, truck, trailer or bus, with the kind of brake lining it must have to survive tomorrow's traffic conditions.

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(A), Paul T. Hahn (M), Harry T. Hawthorn (J), John J. McKinnie (A), Robert A. Pritzker (J), William R. Shimmin (J), Alden B. Staples (A), Angus G. Sturrock (M), George J. Tzantzos (J), Donald William Wanderer (J).

Cincinnati Section

Norman G. Schacht (A).

Cleveland Section

Edward D. Alvord, Jr. (J), Robert P. Buhrow (J), William L. Cratty (A), Raymond S. Gresko (J), Lloyd E. Morris (J), Lawrence J. Nemeth (J), Raymond J. Stewart (M), Mehmet Ayhan Turkkan (J).

Colorado Group

Herbert Earl Johnson, III (J).

Detroit Section

Ellsworth C. Adams (J), Joseph Earl Austerberry (J), Jeremy T. Ball (J), Rudolph Michael Bogre (J), James W. Cooper, Jr. (J), Douglas Dow (M), Francis C. Fleck (J), Lewis Kimple Garis, Jr. (J), Stanley John Garner (J), David A. Gorte (J), Charles M. Heinen (M), Abraham Karapetian (J), Elmer C. Lang (A), Theophil M. R. Lupfer (SM), Joseph John Parthum (J), James Leslie Quinnelly (SM), Robert M. Rodger (M), Alexander Ramsay Ross (J), Edgar T. Schreiner (J), William Stott (M), Richard Chester Teasel (J), Ralph Underdahl (J), Lawrence A. Warzel (J), Julius E. Witzky (M), Robert G. Yingling (M), John Zytkewick (J).

Indiana Section

Robert F. Keller (J), Jack Dallas Peebles (J), Edward Ray Searby (J).

Metropolitan Section

Lee J. Bregenzer (M), Fred O. Dietsch, Jr. (A), Agostino M. Dolza (A), John Henry Dove (M), Eberhard Dullberg (J), Harold V. Dumbleton (M), Leslie P. Holcomb (M), Albert L. Longarini (J), Wallace A. McMillan (M), Harry Tennent Rittenhouse (J), Howard E. Schwiebert (A), Alfred S. Tauber (J).

Milwaukee Section

Raymond G. Horner, Jr. (J), Kenneth G. Jones (M), James W. Mohr (M), Earl Clausing Thayer (J).

Mohawk-Hudson Group

Charles O. McCumber (A).

Montreal Section

Bernard Brunel (A), John Leslie Millen (J).

Continued on Page 118

New Members Qualified

New England Section

Frank E. Brown (A), Michael Dobrolet (M), Cramer W. La Pierre (M), Jack Alexander Saunders (J).

Northern California Section

Hendrix Ragon Bull (J), Thomas J. Turek (M).

Philadelphia Section

Arthur M. Berg (J), John H. Faunce (M), W. Thomas H. MacNew (J), Richard Edward Van Doren (J).

Pittsburgh Section

Adrian E. Dible (A), Bruce E. Markley (A), Irving Earl Schaumberg (J).

St. Louis Section

B. Morris Henderson (J).

San Diego Section

Mrs. Reba W. Vemich (J).

Southern California Section

Richard L. Barter (A), John C. Bartlett (A), Kenneth C. Edson (M), Philip Gindes (A), John Daniel Mark (J), Cecil Allen Potter (M), Douglas L. Schultz (J), John F. Snider (M), David E. Westerling (J).

Texas Section

2nd Lt. Thomas Christian Greenfield (J), Joe Walker Morledge (J), George H. Pollard (M), Frederick Edward Wilson (M).

Twin City Section

Wendell Edward Bergren (J).

Virginia Section

Edward Garland Dorsey, Jr. (J).

Washington Section

Paul Philip Dunn (SM), Charles E. Greeley (M), Raymond Kruger (J), John L. Lackler (M), Robert Louis Meadows (A), Ralph E. Wainwright (A).

Western Michigan Section

D. M. Hesling (M), Paul Louis Vermarie (J).

Williamsport Group

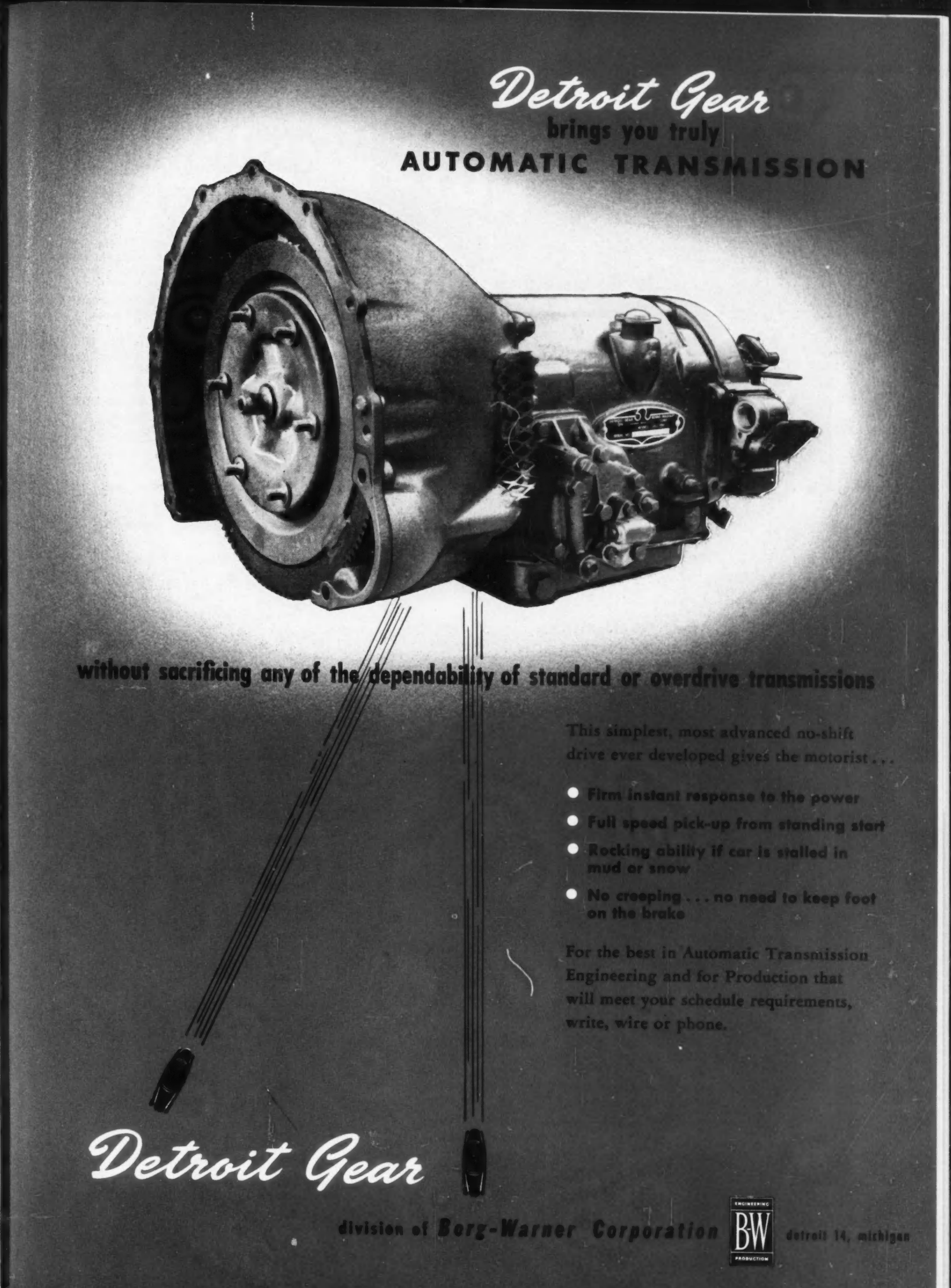
Rafael H. Brand (J).

Outside Section Territory

William George Bloxham (M), John Joseph Devlin (J), Harrold W. Goodnight (J), Ernest Douglas Grocock (J), Louis Arthur Herstein, III (J), Richard L. Mela (J), Ralph Edward Metsker (J), David E. Morris (A), James Oldham (M), Ralph Glenn Simpson, Jr. (J), Manfred Stein (J), Charles Paul Turner (J), Arthur Junior Wolf (J), P. D. Young (A).

Foreign

Stanley Charles Toll (A), So. Africa.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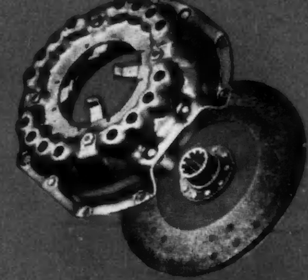

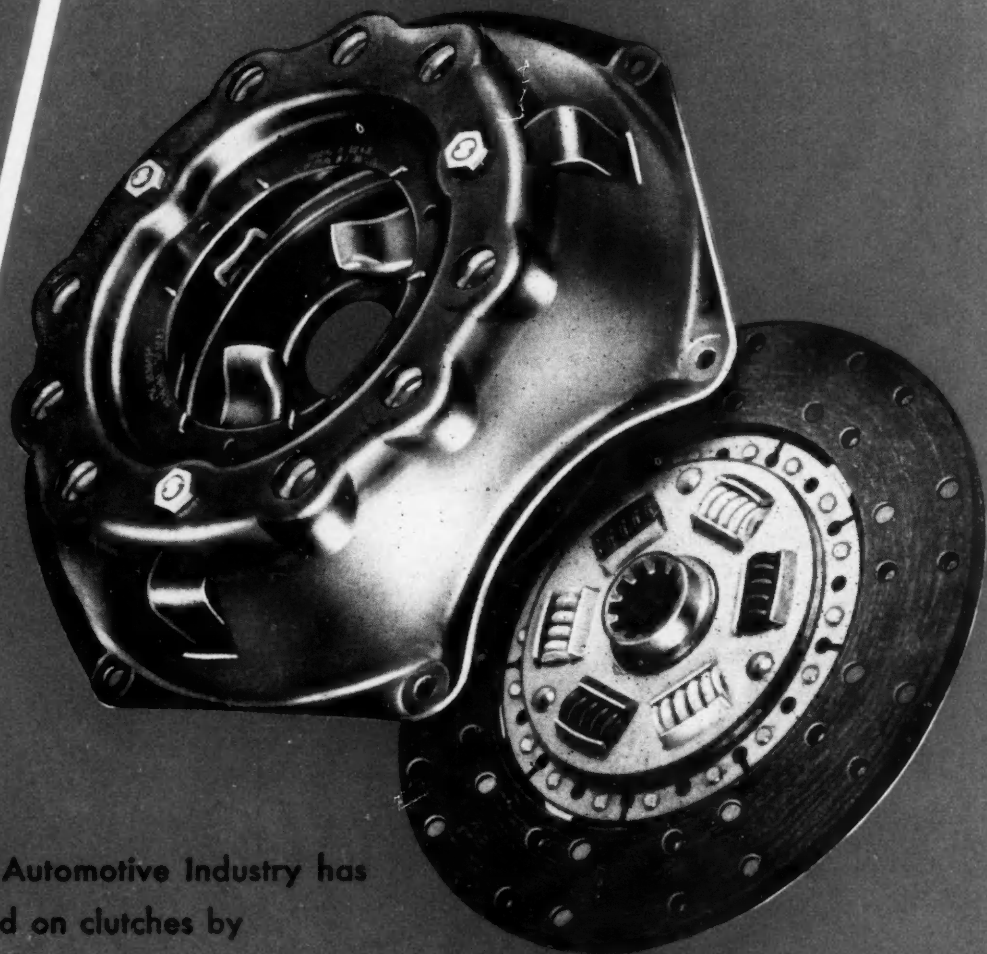

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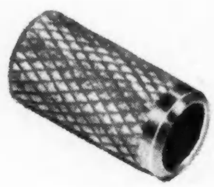

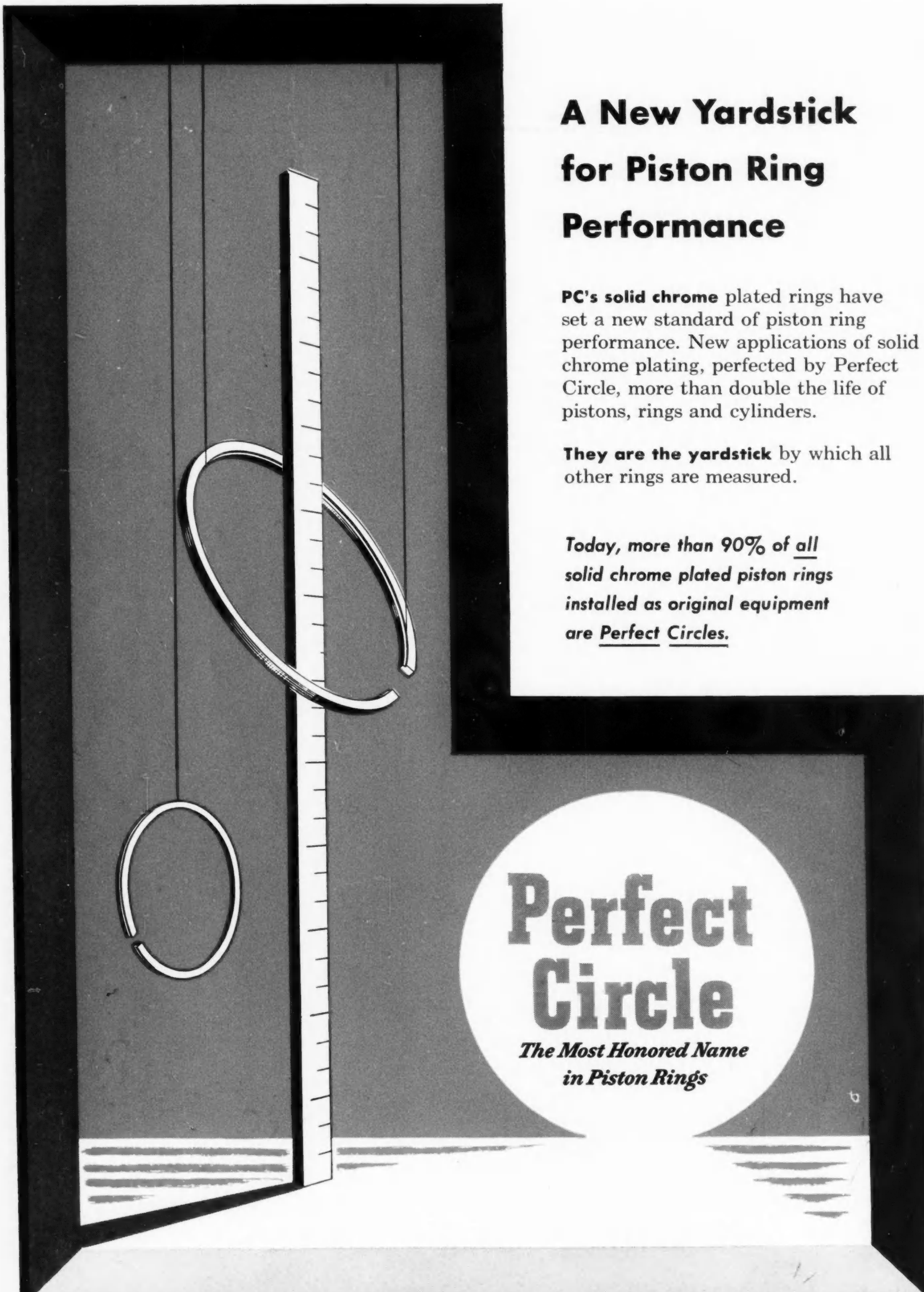
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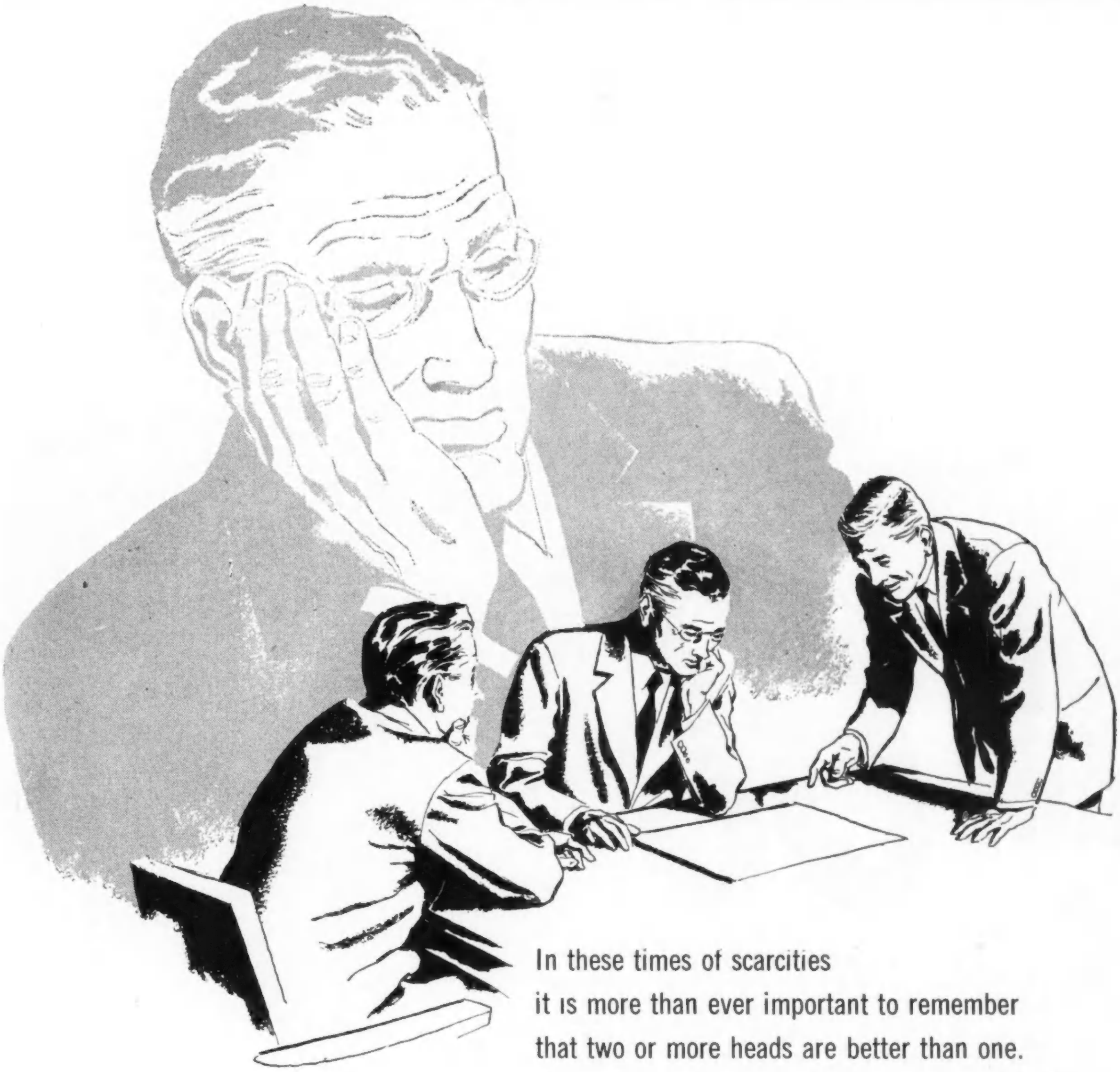

For the Sake of Argument

"What's the Next Step?"

By Norman G. Shidle

In every company, division, or department, somebody has to keep asking: "What's the next step?" It's the anti-stagnation factor in every phase of every operation—large or minute.

Asking is the boss's job. But it's everyone else's opportunity. The less the boss does the asking, the happier he is likely to be—however fast or slow his own rate of uptake.

"The man with the next step in mind automatically sees a future in his work," an executive philosophized the other day. "The sort of fellow who *wants* that question answered is easier to propel into new fields, too."

Certainly some men ask themselves "What's the next step" many times each day. Just as certainly, others wait to have it asked of them.

One man goes to the boss with: "Here are the results of those tire tests you asked us to run." Another leaves it to the boss to ask: "Have you got those tire tests finished yet?" Results in any single instance are little different one way or the other. Long-term results from the two attitudes of mind can be very different.

The first is likely to resemble the smooth acceleration of a car whose engine is fully warm. The latter produces the jerky progress of a car whose cold engine doesn't quite catch. One mind is slightly off-balance toward the future. The other has to be rearranged for each new step after the last one has been taken. One is part of a going operation; the other does a series of partly-isolated jobs. One keeps a solid, integrated front in attacking work problems; the other too often has to fight itself out of pockets.

Of course, the fellow who can answer "What is the next step," as well as want to ask it, is a pearl of even greater price.